

Microwaves & RF

THE HIGH SPEED ELECTRONICS GROUP

News

Reviewing advances in DSPs and data converters

Design Feature

Comparing microwave control devices

Product Technology

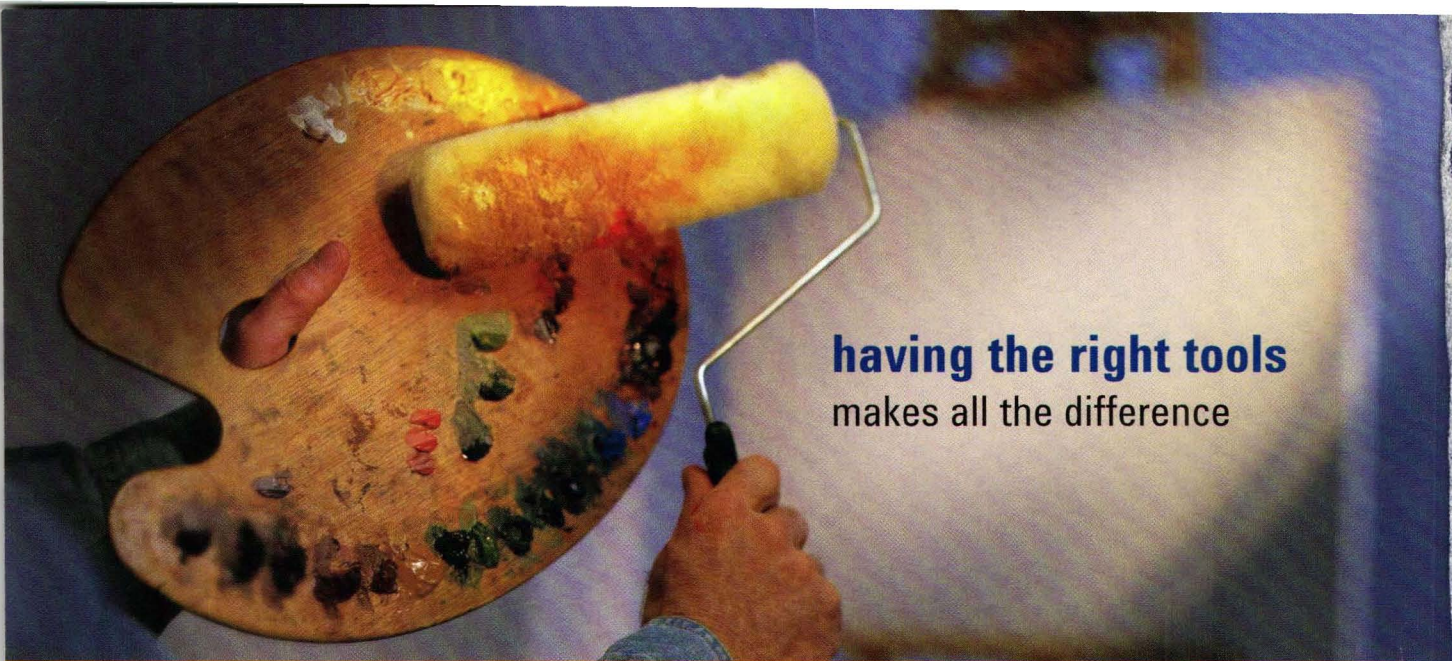
MMIC mixers reach high intercept points

Portable Analyzers Make Military Grade

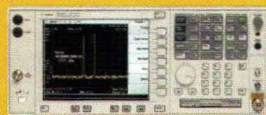


#533579017 5# RF 001 100
*****AUTO**3-DIGIT 543
SCK 512
|||
JOE LORITZ, ENGINEER
GBPPR
424 WILSON AV
GREEN BAY WI 54303-4115

**Semiconductors
Issue**



having the right tools
makes all the difference



**PSA high-performance
spectrum analyzers**



PSG signal generators



**PNA vector network
analyzers**

Tools that match your needs can help you overcome the toughest challenges in microwave and millimeter-wave design — new technologies, narrow margins and complex test requirements. With those problems under control, you can spend less time balancing the compromises between the schedule and your design. That's the vision driving our next-generation measurement platforms, which offer new levels of performance, flexibility and connectivity.

PSA high-performance spectrum analyzers deliver one-button measurements that extract noise figure, phase noise and more from complex signals to 50 GHz.

PSG signal generators offer integrated vector modulation and PC-based tools to create complex, real-world signals with high power and low phase noise to 110 GHz.

PNA vector network analyzers characterize linear and frequency-translating devices — with microwave electronic calibration and vector-corrected mixer techniques — from 10 MHz to 67 GHz.

What's more, combining these instruments with our Advanced Design System (ADS) environment creates a connected solution that can help you achieve even fewer and faster design iterations. See them at **www.agilent.com/find/mwtools**. Or call **800-452-4844** to request an application-seminar CD or schedule an on-site demo.

www.agilent.com/find/mwtools

u.s. 1-800-452-4844, ext. 7700
canada 1-877-894-4414, ext. 7704



Agilent Technologies

dreams made real

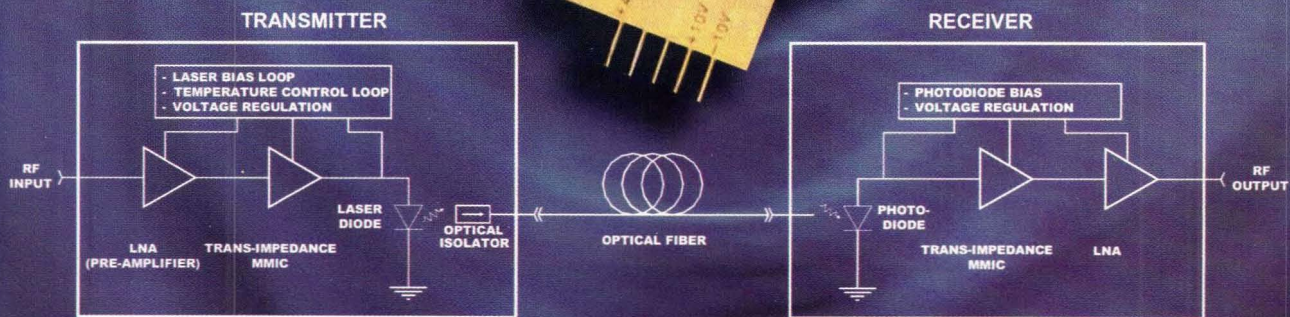
MDD FIBER OPTIC LINK

11 GHz Direct Modulation Microwave Fiber Optic Link

- Small Size
- Bandwidth to 11 GHz
- Low Noise Figure
- Plug-In Optical Connector
- No External Control Circuits Required
- Custom Configurations Available

Applications Include:

- Antenna Remoting
- Local Oscillator Remoting
- Interfacility Communication Links
- Aircraft and Shipboard



For additional information, contact
Dan Sundberg at (631) 439-9269 or e-mail dsundberg@miteq.com



100 Davids Drive
Hauppauge, NY 11788
TEL.: (631) 436-7400 • FAX: (631) 436-7430

miteq.com

AMPLIFIERS FOR EVERY APPLICATION

- Custom built to order
- Delivery in 2 weeks ARO
- Competitive pricing
- Military reliability

RELOCATION COMPLETE!

- ISO 9001 certified
- 100+ years design experience
- New and improved products

Ultra Broadband Amplifiers

Model	Freq. Range GHz	Gain dB min	N/F dB max	Flatness +/-dB	1 dB Comp. pt. dBm min	3rd Order ICP typ	VSWR In/Out max	DC Current mA
JCA018-204	0.5-18.0	25	4.0	2.5	10	20	2.0:1	300
JCA218-506	2.0-18.0	35	5.0	2.5	15	25	2.0:1	400
JCA218-507	2.0-18.0	35	5.0	2.5	18	28	2.0:1	450
JCA218-407	2.0-18.0	30	5.0	2.5	21	31	2.0:1	500
JCA220-209	2.0-20.0	20	6.0	3.0	20	30	2.0:1	500

Power Amplifiers

Model	Freq. Range GHz	Gain dB min	N/F dB max	Flatness +/-dB	1 dB Comp. pt. dBm min	3rd Order ICP typ	VSWR In/Out max	DC Current mA
JCA12-P01	1.35-1.85	35	4.0	1.0	33	41	2.0:1	1000
JCA34-P02	3.1-3.5	40	4.5	1.0	37	45	2.0:1	2200
JCA56-P01	5.9-6.4	30	5.0	1.0	34	42	2.0:1	1200
JCA812-P03	8.0-12.0	40	5.0	1.5	33	40	2.0:1	1700
JCA1218-P02	12.0-18.0	22	4.0	2.0	25	35	2.0:1	700

Low Noise Amplifiers

Model	Freq. Range GHz	Gain dB min	N/F dB max	Flatness +/-dB	1 dB Comp. pt. dBm min	3rd Order ICP typ	VSWR In/Out max	DC Current mA
JCA12-1000	1.2-1.6	25	0.8	0.5	10	20	2.0:1	80
JCA12-3001	1.0-2.0	40	0.8	1.0	10	20	2.0:1	200
JCA23-302	2.2-2.3	30	0.8	0.5	10	20	2.0:1	80
JCA34-301	3.7-4.2	30	1.0	0.5	10	20	2.0:1	90
JCA78-300	7.25-7.75	27	1.2	0.5	13	23	2.0:1	120
JCA910-3000	9.0-9.5	25	1.3	0.5	13	23	1.5:1	150
JCA1112-3000	11.7-12.2	27	1.4	0.5	13	23	1.5:1	150
JCA1415-3001	14.4-15.4	35	1.6	1.0	14	24	2.0:1	200
JCA1819-3001	18.1-18.6	25	2.0	0.5	10	20	2.0:1	200
JCA2021-3001	20.2-21.2	25	2.5	0.5	10	20	2.0:1	200

Millimeter Wave Amplifiers

Model	Freq. Range GHz	Gain dB min	N/F dB max	Flatness +/-dB	1 dB Comp. pt. dBm min	3rd Order ICP typ	VSWR In/Out max	DC Current mA
JCA2629-201	26.0-29.0	19	5.0	1.5	5	15	2.0:1	100
JCA2629-401	26.0-29.0	35	5.0	1.5	5	15	2.0:1	200
JCA2730-205	27.5-30.0	15	5.0	1.0	15	25	2.0:1	200
JCA2730-302	27.5-30.0	26	5.0	1.0	8	18	2.0:1	150
JCA2730-502	27.5-30.0	43	5.0	1.0	8	18	2.0:1	200
JCA3031-102	30.0-31.0	18	5.0	1.5	8	18	2.0:1	100
JCA3031-302	30.0-31.0	34	5.0	1.5	8	18	2.0:1	200
JCA3031-405	30.0-31.0	40	5.0	1.5	15	25	2.0:1	400
JCA2640-301	26.5-40.0	30	5.0	2.5	0	10	2.0:1	160

Product Options:

- Limiting amp
- Variable gain control
- TTL switching
- Temperature compensation
- Alternate gain, N.F., power, VSWR levels
- Input/output isolators
- Waveguide interface

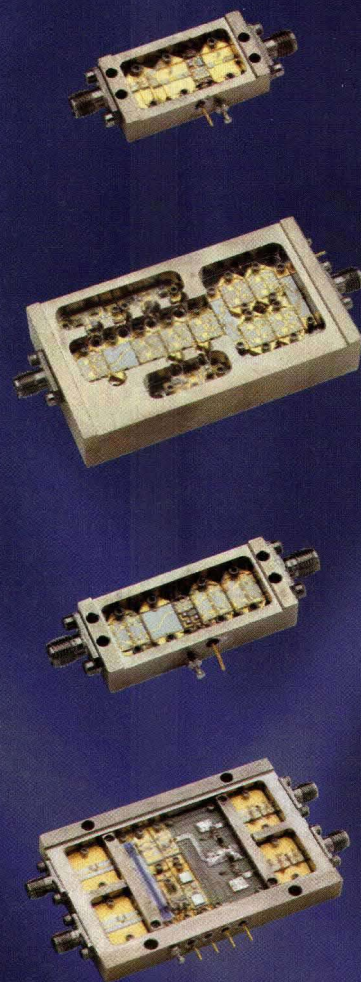
2584 Junction Avenue, San Jose, CA 95134-1902
 p: 408 ■ 919-5300 f: 408 ■ 919-1505
 www.jcatech.com ■ e-mail: jca@jcatech.com

Request for quote!
Call, fax, or e-mail.

Free catalog!
Call or download.

JCA
TECHNOLOGY

a  NEW FOCUS® company



Efficiency at its Best



- #1 Availability of Product
- #1 On-Time Delivery
- #1 Responsiveness
- #1 Overall Performance 11 Years in a Row!



1.800.344.4539 • WWW.DIGIKEY.COM • FAX: 218.681.3380

NO MATTER WHAT YOUR SHORT RANGE APPLICATION, WE HAVE A MEDIUM POWER TRANSISTOR TO DRIVE IT.

Visit us at CTIA Wireless
**BOOTH
4553**
March 17 - 19

WHY DISCRETE POWER?

TWO WAY RADIO. WIRELESS SECURITY.

METER READERS. If you're working on a 150 to 2500 MHz short range design, our medium power devices will get you to market faster and at a lower initial cost than a MMIC solution. Plus discretes offer several inherent benefits: Single power supply

Faster to Market

Lower Price

Greater Design Flexibility

More Efficient

Better Heat Dissipation

operation. Better heat dissipation. And higher efficiency — which can help prolong battery life in your fixed and portable designs. Best of all, with our

broad product offering we probably have a device ideally suited to your specific application. Want data sheets? Visit us online now:

www.cel.com/srw.asp

PART NO.	FEATURES	P _{OUT}	DESCRIPTION
NE5520379A	3 W LDMOS	35 dBm @ 5 V	Applications to 1800 MHz
NE5520279A	1 W LDMOS	32 dBm @ 5 V	Applications to 2.48 GHz
NE552R479A	0.5 W LDMOS	27 dBm @ 5 V	Applications to 2.48 GHz
NE664M04	0.4 W Silicon	26 dBm @ 3.6 V	Driver or Medium Power Output
NE678M04	60 mW Silicon	18 dBm @ 2.8 V	Driver or Medium Power Output
NE677M04	30 mW Silicon	15 dBm @ 2.8 V	Driver or Medium Power Output

CEL California Eastern Laboratories

NEC

A Business Partner of NEC Compound Semiconductor Devices, Ltd.

NEC is a trademark of NEC Corporation.

California Eastern Laboratories ■ Santa Clara, California ■ 408 988-3500

DISTRIBUTORS: Arrow (800) 525-6666 Reptron Electronics (888) 737-8766

Nu Horizons (888) 747-6846 Mouser Electronics (800) 346-6873



Microwaves & RF

MARCH 2003 • VOL. 42 • NO. 3

A Penton
Publication

Visit us at www.planetEE.com

Departments

- 13
Feedback
- 17
Editorial
- 23
The Front End
- 40
Editor's Choice
- 42
Financial News
- 45
Company News
- 46
People
- 48
Educational
Meetings
- 50
R&D Roundup
- 86
Application Notes
- 105
New Products
- 111
Infocenter
- 112
Looking Back
- 112
Next Month



COVER STORY

88 Handheld Analyzers Check Naval Systems

This line of portable analyzers is well suited for the test and analysis requirements of the US Navy in maintaining their sophisticated C⁴I system for battle readiness.

News

- 33
DSPs And Data Converters
Enable Complex
Modulation

Design

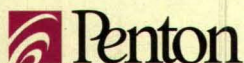
- 53
Comparing High-
Frequency Control Devices
- 62
Wireless Approach
Monitors Tire Pressure
- 72
Sampling IF Filters Fortify
Bluetooth Designs

Product Technology

- 94
MMIC Mixers Reach High
Intercept Points
- 100
Coaxial Connector Is
Type N Alternative
- 102
Combiners/Dividers Range
0.8 To 3.0 GHz

Visit us at PlanetEE.com

Penton Electronics Group's website at www.PlanetEE.com offers a variety of options for engineers. Think of it as a gateway to design information in all areas of electronics, from components to systems. Use it to discuss a favorite topic with top magazine editors at the PlanetEE Discussion boards (www.PlanetEE.com/forums). Comb through current and archived issues of leading electronics magazines, such as *Microwaves & RF*, *Wireless Systems Design*, *Electronic Design*, and *EE Product News*. Search for products and specifiers in two top on-line directories: *Microwaves & RF*'s Product Data Directory Online and *EE Product News*' Product Locator. Learn more about electronic-design trade shows, such as Wireless Systems Design Conference and Expo 2003. Or sign up for an informative E-Newsletter, on topics ranging from EDA to Wireless Networks. All this in just one web page. Just add www.PlanetEE.com to your browser's list of "favorites."



SUBSCRIPTION ASSISTANCE AND INFORMATION:

Microwaves & RF (ISSN 0745-2993) is published monthly, except semi-monthly in December. Subscription rates for US are \$80 for 1 year (\$105 in Canada, \$140 for International). Published by Penton Media, Inc., The Penton Building, 1300 E. 9th St., Cleveland, OH 44114-1503. Periodicals Postage Paid at Cleveland, OH and at additional mailing offices.

Canada Post International Publications Mail (Canadian Distribution Sales Agreement Number 344311). CAN. GST #R126431964. Mail your subscription requests to: *MICROWAVES & RF*, P.O. Box 2095, Skokie, IL 60076. POSTMASTER: Please send change of address to: *MICROWAVES & RF*, P.O. Box 2095, Skokie, IL 60076.

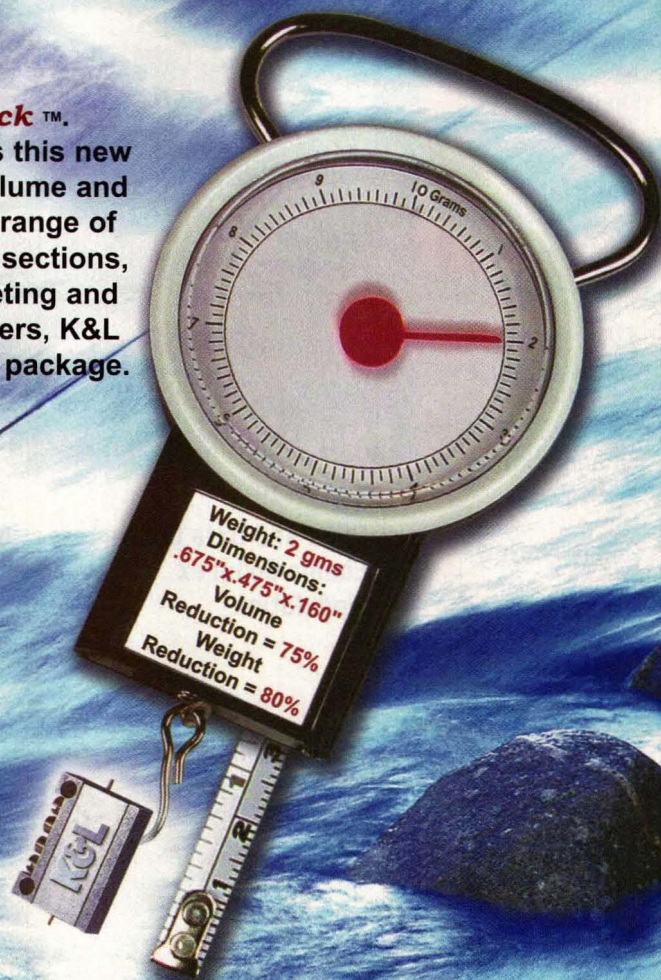


A DOVER™ COMPANY

Mini-Pack™

Minimum Size — Complete Package

K&L Microwave introduces its new **Mini-Pack™**. Compared to standard combines or interdigitals this new cavity filter offers considerable reductions in volume and weight. The **Mini-Pack™** is available in a wide range of frequencies from 6 GHz to 18 GHz with up to 10 sections, making it ideal for military applications. By meeting and exceeding the requirements of most military filters, K&L is offering maximum performance in a complete package.



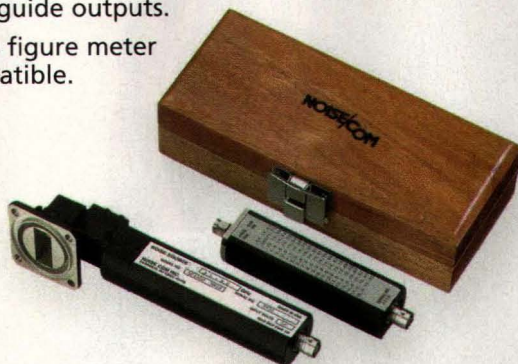
Sometimes SIZE Is Everything

Filtering Solutions for Your Global Market
Visit us online at www.klmicrowave.com
USA: 410-749-2424 * sales@klmicrowave.com * UK: 44-(0)-1908-224746 * sales@kleurope.com

nc346 series

Broadband Precision Calibrated Noise Sources

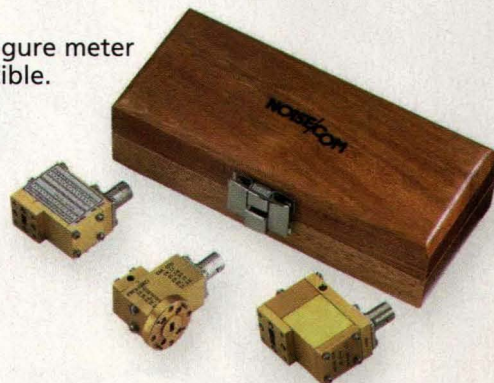
- Designed for precision noise figure measurement applications.
- Available with coaxial or waveguide outputs.
- Noise figure meter compatible.



nc5000 series

Broadband Calibrated Millimeter-wave Noise Sources

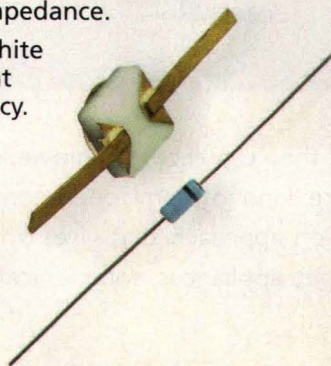
- Designed to replace cumbersome gas-tube noise sources.
- Provide stability, switching speed and ripple-free response over standard waveguide bands.
- Provide narrow or wideband performance with low or high output.
- Noise figure meter compatible.



nc100-400 series

Chips and Noise Diodes

- Designed for microwave applications requiring a 50-ohm impedance.
- Deliver symmetrical white Gaussian noise and flat output versus frequency.
- Available in a wide variety of package styles and special configurations.



Every day,
our noise
components
pass the
toughest
test there is.

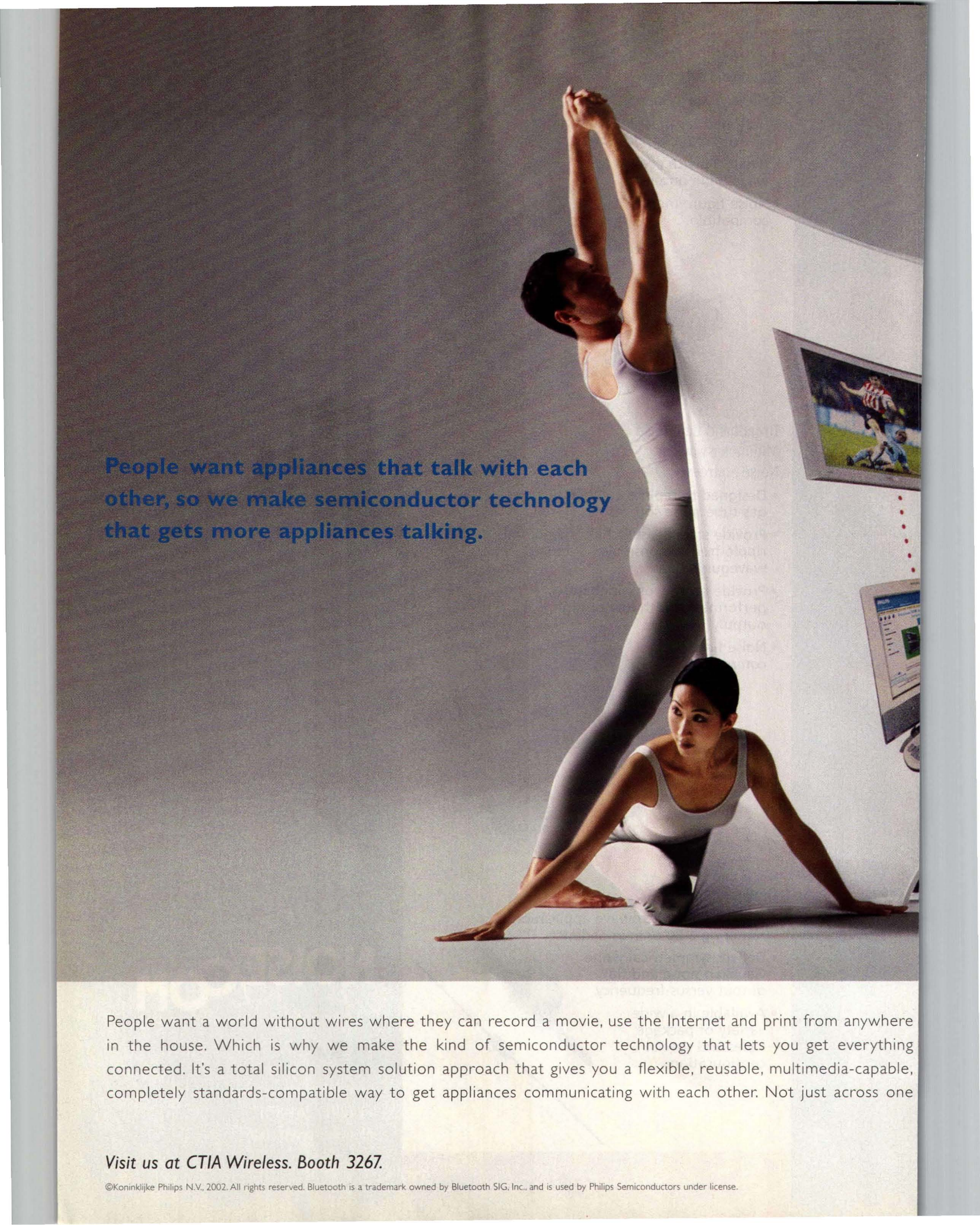
Yours.

Real World Experience.
World Class Solutions.

NOISE/COM

A WIRELESS TELECOM GROUP COMPANY

www.noisecom.com
+1 (201) 261-8797
info@noisecom.com



People want appliances that talk with each other, so we make semiconductor technology that gets more appliances talking.

People want a world without wires where they can record a movie, use the Internet and print from anywhere in the house. Which is why we make the kind of semiconductor technology that lets you get everything connected. It's a total silicon system solution approach that gives you a flexible, reusable, multimedia-capable, completely standards-compatible way to get appliances communicating with each other. Not just across one

Visit us at CTIA Wireless. Booth 3267.

©Koninklijke Philips N.V., 2002. All rights reserved. Bluetooth is a trademark owned by Bluetooth SIG, Inc., and is used by Philips Semiconductors under license.



network standard, but across all network standards: PAN (ZigBee, Bluetooth), LAN (802.11, Wireless 1394) and WAN (GSM, CDMA). We're even leading the way in USB with the first USB On-the-Go solution. It's living technology. And it's only from Philips. For complete technical information and applications overview, visit us at www.semiconductors.philips.com/connectivity.

PHILIPS

Let's make things better



SUCOFLEX® 100

The High-Performance Microwave Cable Assembly

- Superior electrical and mechanical performance
- Comprehensive range of connectors
- Cable armouring options for extreme environmental conditions
- For demanding applications up to 50 GHz

SUCOFLEX® ... setting the standard in Test+Measurement



HUBER+SUHNER

HUBER+SUHNER AG
Mobile Communications+Electronics
9100 Herisau, Switzerland
Phone +41 (0)71 353 41 11
Fax +41 (0)71 353 45 90
www.hubersuhner.com

USA and Canada:
Toll free 1 866 HUBER SUHNER
(1-866-482-3778)
Fax: 1-847-397-2882
www.hubersuhnerinc.com

HUBER+SUHNER – Excellence in Connectivity Solutions

THE FAMILY THAT MEASURES UP |||||



Introducing application specific solutions for the RF and Microwave Field Testing Industry



SITE MASTER®

The proven leader in handheld cable and antenna system analyzers that technicians have come to trust.



SPECTRUM MASTER™

The ideal on-site survey and testing tool, providing spectrum analysis anywhere, anytime.



CELL MASTER™

The ultimate tool for cell site technicians providing complete antenna, cable, and base station analysis.

Field proven leader of application specific Handheld RF and Microwave Analyzers now provides a family of handheld solutions for all of your cell site needs. Once again, Anritsu has set the standard with this array of application specific solutions.

- Field Proven
- Rugged
- Less than 5 lbs.
- Easy-to-Use
- Anritsu Quality

When you need Anritsu precision and quality in a field friendly solution call 1-800-ANRITSU, or check

www.us.anritsu.com/family/126



A Family of Measuring Tools

Anritsu

Discover What's Possible®

Sales Offices: USA and Canada 1-800-ANRITSU, Europe +44-1582-433433, Japan 81(03)3446-1111, Asia-Pacific 65-2822400, South America 55(21)527-6922, www.us.anritsu.com ©2003 Anritsu Company.

HIGH VOLUME 6" WAFER



PRODUCTION FROM...

Filtronic

Filtronic has supported its customers with a well-established line of pHEMT semiconductors for several years. Our packaged pHEMTs, discrete pHEMTs, and MMICs have found wide acceptance for applications in base station receivers and transmitters, WLAN products, mmWave radios, military applications, and others.

Fabrication of these products has been transitioned to Filtronic Compound Semiconductor Ltd. in the United Kingdom. This ultra-modern facility is the largest GaAs wafer fab in Europe and one of the

largest in the world. It features six inch wafer processing and state-of-the-art process controls, making it possible to offer products with consistent performance and competitive pricing.

Support for our customers has been enhanced, with Design Engineering, Sales and Marketing, and Applications Engineering located in both Santa Clara, California and Newton Aycliffe, UK. Contact us to discuss how the Filtronic products you used the past just got even better.



Visit our website at www.filcs.com

3251 Olcott Street, Santa Clara, CA 95054-3095 • Phone (408) 988-1331 • FAX (408) 970-9950

New RF Ideas Are Needed

Editor's Note: The first part of this letter was published in the Feedback section in the February 2003 issue of Microwaves & RF (p. 13). In that first part, Mr. Alechno discussed the pessimism in the RF industry and the need for advanced forums for industry tutorials and discussion.

►►WIDELY CIRCULATED print publications like *Microwaves & RF* and other types of wide communication are almost out of function. As is well known, journals such as *Microwaves & RF* must keep some relation of ads/arts and in lean times such as those we are currently experiencing, the space is strictly limited. For example, I have waited some three years lately to have some of my work published. I have in stock papers written just with the attitude sketched above. One of these

papers concerns amplifier-stability factors and is still awaiting publication in another magazine two years after it was accepted. I do not know what I'm going to do with my last paper, on PLL basics.

I am coming to the conclusion that a new form of instant publishing is needed for the microwave and RF industry, something intermediate between the two that I have considered in this letter. It could be called Internet Microwaves & RF Archives, and, as the name suggests, could be organized by *Microwaves & RF* magazine. This would be the means for instant online publishing for every article and shorter communication sent to the magazine and initially reviewed. *Microwaves & RF* could take the articles and shorter pieces that have been downloaded most often, edit them as per magazine specifications, and run the edited versions in the print edition of the magazine.

For *Microwaves & RF*, it would be an opportunity to increase the popularity of its website, as well as furthering the profile of the print publication. Furthermore, their Web forum, now fading, could be used for discussion of archives content.

Stan Alechno
Rawar
alechno@wa.onet.pl



PLEASE COMMENT

Microwaves & RF welcomes mail from its readers. Letters must include the writer's name and address. The magazine reserves the right to edit letters appearing in "Feedback." Address letters to:

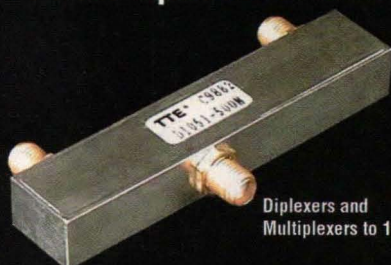
Jack Browne
Publisher/Editor
Microwaves & RF
Penton Media, Inc.
45 Eisenhower Dr., 5th Floor
Paramus, NJ 07652
e-mail: jrbrowne@penton.com

1,239,580 Filters

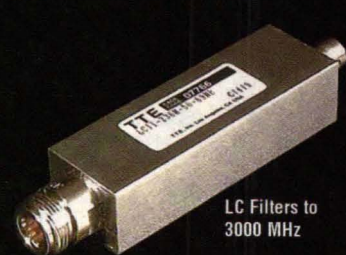
America's Filter Specialist since 1956



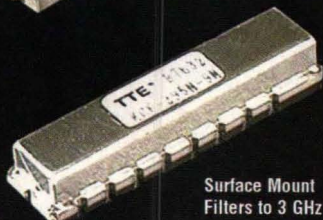
Comline & Interdigital
Filters to 18 GHz



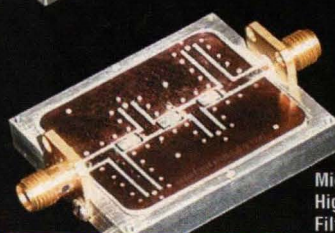
Diplexers and
Multiplexers to 18 GHz



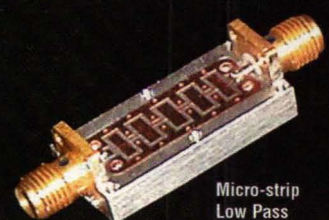
LC Filters to
3000 MHz



Surface Mount
Filters to 3 GHz



Micro-strip
High Pass
Filters to 18 GHz



Micro-strip
Low Pass
Filters to 18 GHz

Western Regional Sales Office:

11652 W. Olympic Blvd.
Los Angeles, CA 90064

Ph: 800.776.7614 310.478.8224
Fax: 800.473.2791 310.445.2791

E-mail: sls@tte.com

TTE®
www.tte.com



Eastern Regional Sales Office:

St. Pete Beach, FL

Toll Free: 866.363.0849

Ph: 727.363.0849

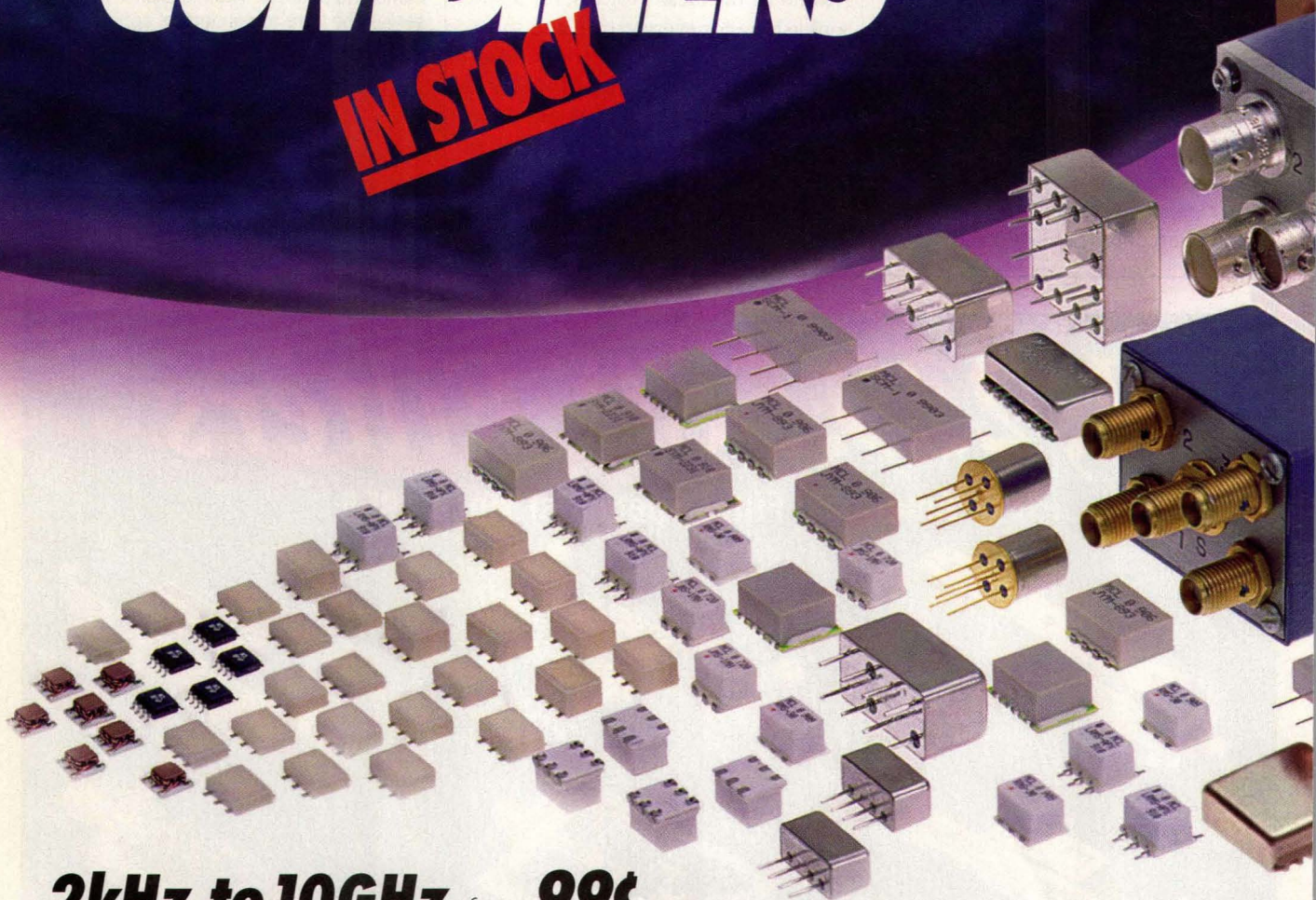
Fax: 727.363.7639

E-mail: sls@tte.com

THE WORLD'S LARGEST SELECTION

POWER SPLITTERS/ COMBINERS

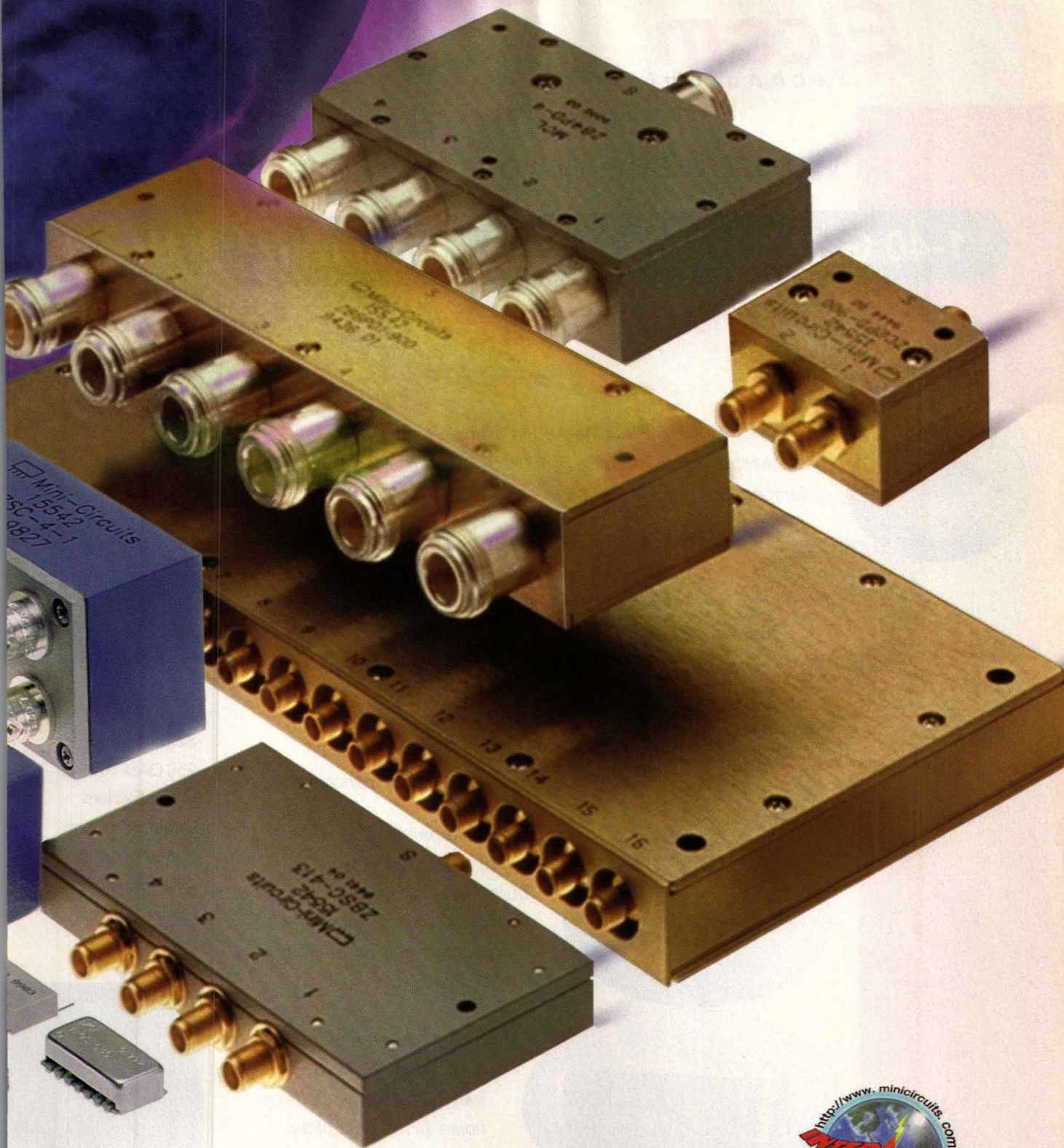
IN STOCK



2kHz to 10GHz from 99¢

Choose from thousands of off-the-shelf models from Mini-Circuits, in stock and immediately available! From 2 and 3way to 48way; 0°, 90°, 180°; 50 & 75 ohms covering 2kHz to 10GHz and beyond...all characterized with data and performance curves in our catalog and "The YONI Search Engine" at our web site. Mini-Circuits will also supply your special needs and custom designs such as wider bandwidths, higher isolation, lower insertion loss and phase matched ports...all at catalog prices with rapid turnaround time. Case styles include surface mount, plug-in, flat pack, coaxial connectorized...and custom packages are no problem! Our super-miniature and ultra-low profile Blue Cell™ surface mount units provide excellent solutions in cellular, cable, and countless wireless applications. Plus all units come with a 1 year guarantee and skinny 4.5 sigma performance repeatability. Add unsurpassed applications support and value pricing, and the decision is easy. Contact Mini-Circuits today!

Mini-Circuits...we're redefining what VALUE is all about!



see us on the web
<http://www.minicircuits.com>



Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

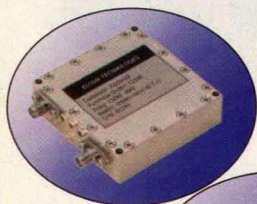
ISO 9001 CERTIFIED

F 194 Rev D

We are ready for your challenge.

1-40 GHz Synthesizers & Oscillators

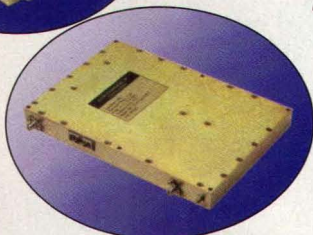
Zero Phase Hits over Full Temperature range.



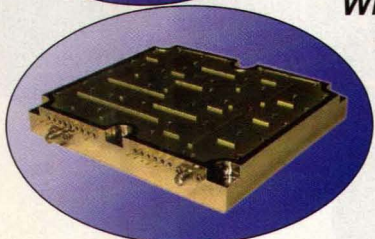
SPDRO 1-26 GHz. Phase locked in a single loop,
5-200 MHz reference, -130 dBc @ 100KHz. Offset 10 GHz,
Temperature range from -55 to +85 celsius



DFS For digital radio up to 38 GHz & 256
QAM, Ultra Low phase noise (-123 dBc 100 KHz
offset 9GHz signal), Meets ETSI 300019-1-4



MFS Half octave indirect, 1-26 GHz. for
portable and transportable SATCOM
converters, Ultra Low phase noise,
Integrated fixed L-band PDRO,
Ruggedized, very Low Microphonics



WMFS Octave bandwidth indirect,
up to 18 GHz, 1Hz step,
100 microsecond switching,
Low phase noise, Ruggedized
Hermetically sealed package,
Compact size 5"x5"



UFS Broadband direct up
to 40 GHz, 200 NSEC
switching, -153 dBc phase
noise @100 KHz offset
from 10 GHz signal

- Satcom Converters
- 256 QAM Radios
- Radar Exciters
- Target Simulation
- Instrumentation
- Avionic Testers
- Custom Units

www.elcom-tech.com

Sometimes, It's Just Stubbornness

SURVIVAL IN BUSINESS OFTEN requires fortitude and vision, and generally a determination to outlast one's competition. Sometimes, survival is simply a matter of being too stubborn to give up on an idea or a conviction. In the current challenging economic environment, some lessons in stubbornness might serve as inspiration for engineers striving for creativity while witnessing cutbacks in budgets, in staffing, and in support.

One of the more inspirational speakers in this industry, Doug Lockie, executive vice-president and founder of Endwave Corp. (Sunnyvale, CA, www.endwave.com), chaired a session on Broadband Wireless strategies and technologies at the recent Wireless Systems Design Conference & Expo. Doug has long been fascinated with millimeter-wave technology, in spite of its military association and its reputation for being expensive.

Doug's faith in the future of millimeter-wave technology is infectious, and his many contacts within the industry helped him to assemble one of the better-attended technical sessions at the Wireless Systems Design Conference & Expo. Included in those sessions was a presentation of particular note by Dave Stephenson, engineering manager for Bridge Products at Cisco Systems (San Jose, CA, www.cisco.com), who spoke of the tremendous potential for connecting the computer networks of more than 700,000 business buildings by means of millimeter-wave Gigabit class radios (currently, only about 8000 buildings are connected, by optical fiber). The presentation brought a measure of increased credibility to millimeter-wave techniques, with Cisco's obvious interest in the technology.

Another story of stubbornness/perseverance emerged from the humble but ingenious Dr. Richard Ruby, director of technology for the Wireless Semiconductor Division of Agilent Technologies (Newark, CA). His belief that high-frequency filters could be accomplished by means of processing acoustic waves was initially dismissed in the early 1990s by the company's (at that time Hewlett-Packard Co.) management as too impractical. Undaunted, he stuck to his beliefs in the approach, making his own investments in equipment and time for several years until finally fabricating some filters that made management take notice. Ironically, that technology—film bulk acoustic resonator (FBAR)—has accounted for shipments of more than 10 million cellular duplexers since the FBAR products were introduced in 2001.

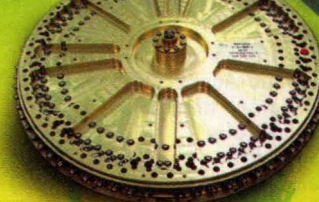
Certainly, there are many more stories like these. They are good examples that great ideas are not always recognized at first, but that sometimes stubbornness can eventually lead to success.



Sometimes, survival is simply a matter of being too stubborn to give up on an idea or conviction.

Jack Browne
Publisher/Editor

PASSIVE COMPONENTS, ASSEMBLIES & SCREENING SERVICES FOR HI-REL & SPACE APPLICATIONS



Combiner/Divider Features & Options:

- Designed for High Power Levels (Up to 30 KW output)
- Frequency ranges from UHF to 30 GHz
- Space & Hi-Rel Military Qualified
- Integrated phase matched isolators

Model No.	Type	Input & Output VSWR	Insertion Loss (dB)	RMS Amplitude Variation (+/- dB)	Absolute Amplitude Variation (+/- dB)	RMS Phase Variation (+/- deg)	Absolute Phase Variation (+/- deg)
CWC081-XXX*	8:1	1.4:1	0.30	0.25	0.50	1.5	3
CWC161-XXX*	16:1	1.4:1	0.30	0.25	0.50	1.5	3
CWC241-XXX*	21:1	1.4:1	0.30	0.25	0.85	2.0	3
CWC321-XXX*	32:1	1.4:1	0.50	0.30	0.85	2.0	4
CWC361-XXX*	36:1	1.4:1	0.50	0.30	0.95	2.0	4
CWC481-XXX*	48:1	1.4:1	0.60	0.40	0.95	4.0	5
CWC501-XXX*	50:1	1.4:1	0.60	0.40	0.95	4.0	5
CWC641-XXX*	64:1	1.4:1	0.60	0.50	1.20	5.0	8
CWC681-XXX*	68:1	1.4:1	0.60	0.50	1.20	5.0	8

*PIN to be completed after receipt of actual FREQ range
**For Divider substitute the letter "D" in place of the 2nd letter "C"

Other Products Include:

- Filters (Space/Hi-Rel)
- Multiplexers and Couplers
- OMT/Polarizers
- Environmental Screening & Qualification Services



Ciao Wireless, Inc.

4000 Via Pescador • Camarillo, CA 93012
Tel (805) 389-3224 • Fax (805) 389-3629
E-mail Sales@CiaoWireless.com
CiaoWireless.com

Visit us on-line at:

rfwireless.rell.com/tmcat.asp

to receive your **FREE**
RF/Microwave Test and
Measurement Accessories
and Components Product Guide

- Splitters and Combiners
- Couplers
- Amplifiers
- Circulators and Isolators
- Heatsinks/Thermal Management Products
- Adapters
- Cables
- Connectors
- Tools and Accessories
- Attenuators and Terminations
- Waveguide
- Fiber Optics and more!

NEW!



Richardson Electronics
Engineered Solutions

1-800-RF POWER (1-800-737-6937)

rfwireless.rell.com/tmcat.asp

rwc@rell.com



Microwaves & RF
www.mwrf.com

Your gateway site to

Planet EE
Penton Electronics Group

Microwaves & RF

A Penton Publication

HIGH-SPEED ELECTRONICS GROUP

Group Publisher Craig Roth, (201) 845-2448 • croth@penton.com

Publisher/Editor Jack Browne, (201) 845-2405 • jbrowne@penton.com

Technology Editor Nancy Konish, (201) 845-2428 • nkonish@penton.com

Associate Managing Editor John Curley, (201) 845-2415 • jcurley@penton.com

Special Projects Editor Alan ("Pete") Conrad

Editorial Assistant Dawn Prior • dprior@penton.com

Contributing Editors Andrew Laundrie, Allen Podell

MANUFACTURING GROUP

Director Of Manufacturing Ilene Weiner

Group Production Director Mike McCabe

Customer Service Representative

Dorothy Sowa, (201) 845-2453, fax: (201) 845-2494

Production Coordinator Judy Osborn, (201) 845-2445

ART DEPARTMENT

Art Director Armand Veneziano • aveneziano@penton.com

Group Design Manager Anthony Vitolo • tvitolo@penton.com

CIRCULATION CUSTOMER SERVICE (LIVE) (847) 647-6657

microwaves&rf@halldata.com

Reprints (800) 217-7874

EDITORIAL OFFICE

Penton Media, Inc.

45 Eisenhower Dr., Fifth floor, Paramus, NJ 07652

Phone: (201) 845-2446, fax: (201) 845-2493

PENTON TECHNOLOGY MEDIA

President David B. Nussbaum

VP, HR and Organizational Effectiveness Colleen Zelina



Chairman & Chief Executive Officer Thomas L. Kemp

President & Chief Operating Officer Daniel J. Ramella

Senior VP/Interim Chief Financial Officer Preston L. Vice

Chief Technology Officer R. Thomas Jensen

Exec. VP and President,

Penton Technology & Lifestyle Media David B. Nussbaum

Exec. VP & President, Penton Industry Media William C. Donohue

President, Penton Retail Media John J. Meehan

Senior VP, Human Resources Katherine P. Torgerson

VP & Controller Jocelyn A. Bradford

VP, Investor Relations Mary E. Abood

International editions are shipped via several entry points, including: Editeur Responsable (Belgique), Vuurgatstraat 92, 3090 Overijse, Belgique.

Microwaves & RF is sent free to individuals actively engaged in high-frequency electronics engineering. In addition, paid subscriptions are available by writing to: Microwaves & RF, P.O. Box 2095, Skokie, IL 60076.

Prices for non-qualified subscribers are:

Single Copies

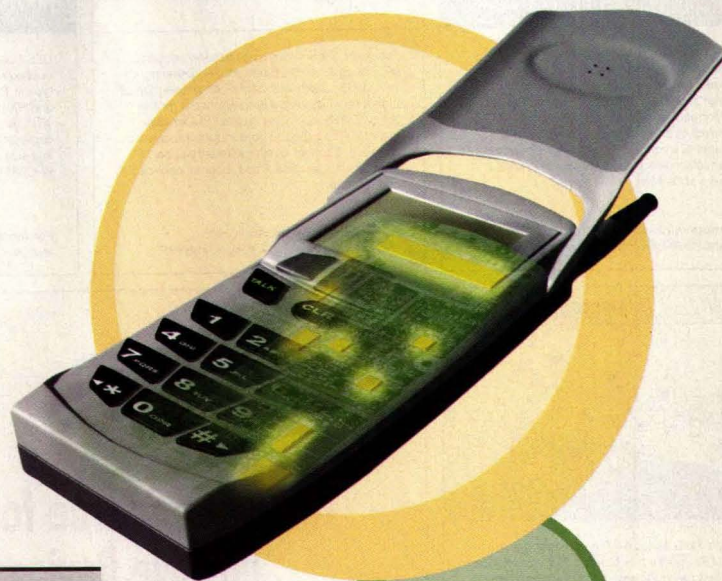
	1 Yr.	Regular Issues	PDD Only
U.S.	\$ 85.00	\$10.00	\$100.00
Canada	\$110.00	\$12.00	\$125.00
Mexico	\$145.00	\$14.00	\$125.00
All other countries	\$145.00	\$16.00	\$125.00

Back issues of **MicroWaves** and **Microwaves & RF** are available on microfilm, microfiche, 16-mm, or 35-mm roll film. They can be ordered from Xerox University Microfilms, 300 North Zeeb Rd., Ann Arbor, MI 48106. For immediate information, call (313) 761-4700. Copying: Permission is granted to users registered with the Copyright Clearance Center, Inc. (CCC) to photocopy any article, with the exception of those for which separate copyright ownership is indicated on the first page of the article, provided that a base fee of \$1.25 per copy of the article plus 60 cents per page is paid directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. (Code 0745-2993/02 \$1.25 +.60) Copying done for other than personal or internal reference use without the expressed permission of Penton Media, Inc., is prohibited. Requests for special permission or bulk orders should be addressed in writing to the publisher.

Copyright © 2003 by Penton Media, Inc. All rights reserved. Printed in the U.S.

BUILD YOUR FUTURE WITH SAWTEK!

Sawtek delivers a full line of RF SAW filters for all your design needs. Our expanded capacity and product portfolio make Sawtek your supplier of choice. These products – plus a complete line of SAW filters for worldwide wireless architectures – are setting a new standard for performance and dependability.



SAWTEK'S DUPLEXERS

Frequency (MHz)	Application	Mode
836.0/881.0	Cellular Duplexer	SE
1765.0/1855.0	KPCS Duplexer	SE

Sawtek...Your Supplier of Choice!

SAWTEK'S RF FILTERS

Frequency (MHz)	Application	Mode
836.5	Cellular Tx	SE
881.5	Cellular Rx	SE
881.5	Cellular Rx	SE/BAL 100 Ω
942.5	EGSM Rx	SE
942.5	EGSM Rx	SE/BAL 50 Ω
942.5	EGSM Rx	SE/BAL 200 Ω
1575.0	GPS Rx	SE
1575.0	GPS Rx	SE/BAL 100 Ω
1765.0	KPCS Tx	SE
1842.5	DCS Rx	SE/BAL 50 Ω
1842.5	DCS Rx	SE/BAL 200 Ω
1855.0	KPCS Rx	SE
1855.0	KPCS Rx	SE/BAL 100 Ω
1880.0	U.S. PCS Tx	SE
1960.0	U.S. PCS Rx	SE
1960.0	U.S. PCS Rx	SE/BAL 100 Ω
1960.0	U.S. PCS Rx	SE/BAL 200 Ω

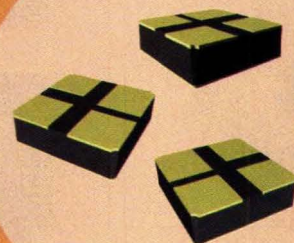
 **SAWTEK**
a TriQuint company 

www.sawtek.com

Phone: (407) 886-8860

Fax: (407) 886-7061

E-mail: info@sawtek.com



M/A-Com



M/A-Com's new MABAES series Balun Transformers provide the perfect balance between low cost and high performance. Offered in various impedance ratios, these transformers are ideal for converting the balanced outputs of today's broadband IC converters, into a PCB friendly single ended transmission line format. Frequency ranges from 5 - 1000 MHz.

For more information log onto:
www.avnetRF.com/passivesguideMWRf

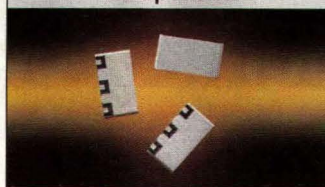
Johanson Technology



Johanson Technology's application specific (WLAN, 802.11a+b, Bluetooth) engineering kits provide RF designers with a broad selection of high frequency ceramic components for the 2.4 or 5 GHz operating bands. The kits also include JTI's capacitor and inductor modeling software. Each kit contains antennas, band pass filters, low pass filters, baluns, capacitors and inductors.

For more information log onto:
www.avnetRF.com/passivesguideMWRf

CTS Communication Components



CTS Communication Components wireless duplexer has a profile of less than 2.0 mm, typical TX IL of 1.2 and rejections in the TX and RX bands of better than 50.0 dB and 45.0 dB respectively. The KFF6669A W-CDMA duplexer is ideal for the demanding performance and size requirements of today's new W-CDMA radios.

For more information log onto:
www.avnetRF.com/passivesguideMWRf

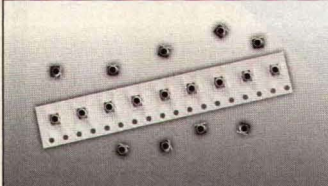
CTS Communication Components



CTS Communication Components has introduced a new family of frequency translators for communications networking applications. The product is utilized to convert an available reference frequency to a desired output. A typical example would be a 19.44 MHz input with a 622.08 MHz output.

For more information log onto:
www.avnetRF.com/passivesguideMWRf

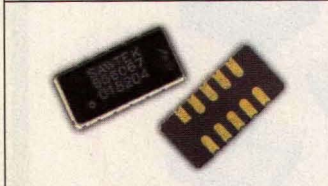
Murata



Murata SWD series switch connector, p/n: MM8430-2600B, has found major acceptance as a test measurement point on pcbs. It may be used on all DC to 6 GHz applications where a test point is required. Its small 3.0 mm L x 3.0 mm W x 1.75 mm H size permits use in many applications. It is surface mountable and reflow solderable.

For more information log onto:
www.avnetRF.com/passivesguideMWRf

Sawtek

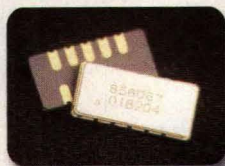


Sawtek's redesign of our original DIP line of 70 MHz and 140 MHz SAW filters is complete. You now have the option of high-selectivity performance with all the advantages of the ceramic SMP packaging that the low-loss 70 MHz and 140 MHz filters have enjoyed for years.

For more information log onto:
www.avnetRF.com/passivesguideMWRf



Your Best Source for RF & Microwave Passive Devices



Avnet RF & Microwave is the best source for passive devices, providing the industry's broadest and largest product offering of RF and microwave filters, capacitors, inductors, couplers, splitters, transformers and relays. Avnet RF & Microwave has differentiated itself as the clear industry leader serving the wired and wireless markets by:

Inventorying a broad array of passive products from over 12 device and component manufacturers.

Developing parametric search tools that enable design engineers to find the device best suited for specific applications.

Creating an RF-dedicated technical selling organization with in-depth product knowledge and expertise.

Offering a wide range of manufacturing and value-added services through Avnet Microwave Technical Solutions (AMTS).

Offering more purchasing choices — over-the-phone at 866.Avnet.RF (286-3873) or online at www.avnetRF.com

For more information on Avnet RF & Microwave's passive product offering, or to place an order, visit www.avnetRF.com or call 866.avnet.RF (286-3873)

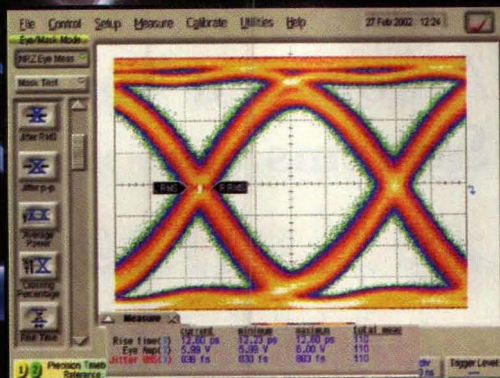


1.866.avnet.RF
(286-3873)

www.avnetRF.com/passivesguideMWRf



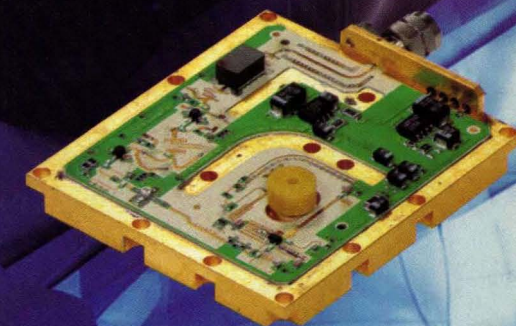
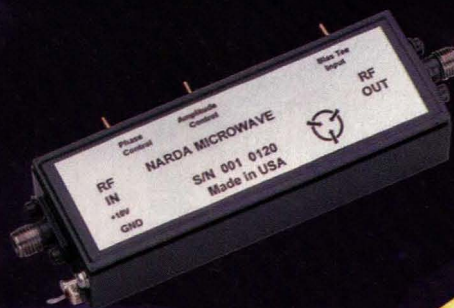
866.avnet.RF (286-3873)



LN Driver at 43 Gb/s

Looking for high performance OC-192 and OC-768 fiber optic product solutions?

Take a look at our new OC-768 Modulator Drivers (output to 8 volts, ≥ 44 Gb/s, jitter ≤ 0.5 fs), new ultrastable DRO based Clock Oscillators, and Clock Recovery Circuits.



...YOUR SEARCH IS OVER.

For more than 45 years Narda has been a world supplier of high performance microwave and millimeterwave products for communications, industry, space and defense. Our new fiber optic product line provides the optimum combination of performance and cost... And is ideally suited for fiber optic OC-192 and OC-768 systems.

For detailed specifications on our high performance fiber optic products, give us a call today.

narda

an **L3** communications company

435 Moreland Road • Hauppauge, NY 11788

USA Tel: 631.231.1700

Int'l Tel: 631.231.1390 • FAX: 631.231.1711

e-mail: nardaeast@L-3com.com

www.nardamicrowave.com

HIGH PERFORMANCE FIBER OPTIC PRODUCTS

OC-768 LN and EA
Modulator Driver Amplifiers

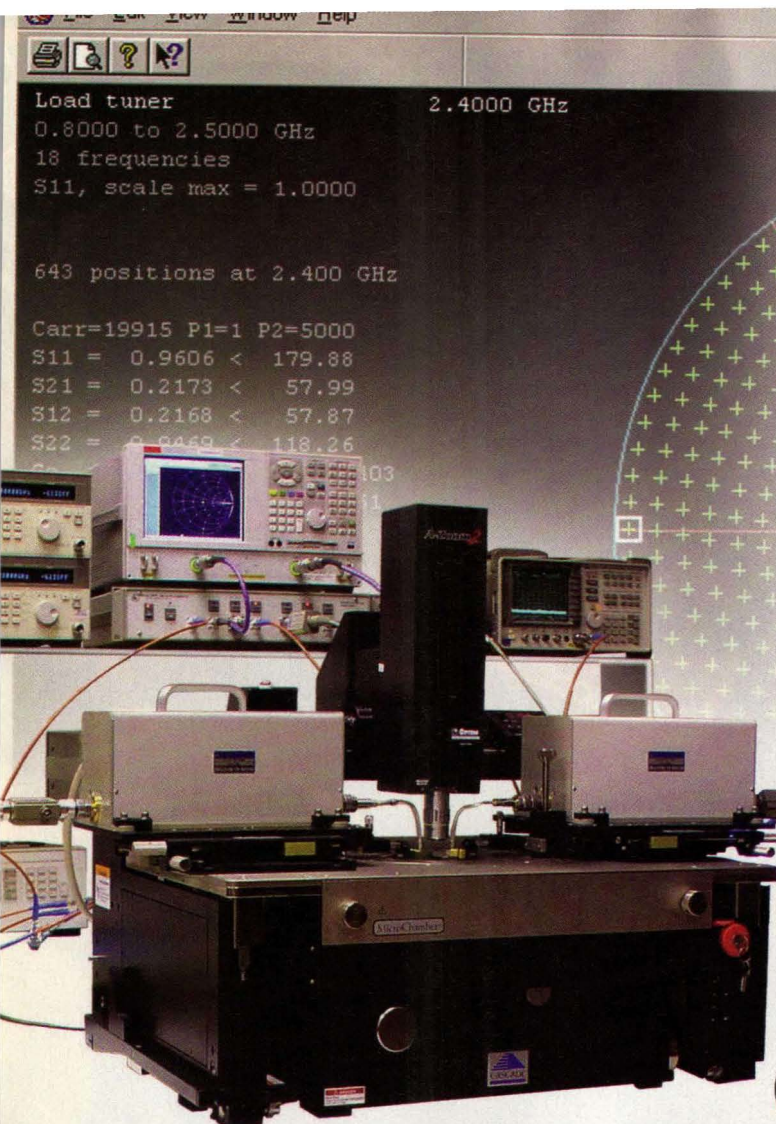
OC-768 Full/Half Rate
Clock Oscillators

OC-768 Clock Recovery Circuits

OC-192 Full/Half/Fourth Rate Clock Oscillators

OC-192 Broadband Data Amplifiers

OC-192 and OC-768 Clock Amplifiers



Maury MT982E32 tuners in a typical on-wafer setup.

Maury's New MT982E32 Tuners are Optimized for 2.4 GHz and 5.1 GHz

- Ideal for WLAN, Wi-Fi, Bluetooth and WCDMA
- Precision Positioners Eliminate Vibration
- Tuner Integration Adapter for On-Wafer Applications
- Common C++ Software Platform
- ADS/Microwave Office Data Format
- Application Specific Modules
- Fixture and Pad De-Embedding

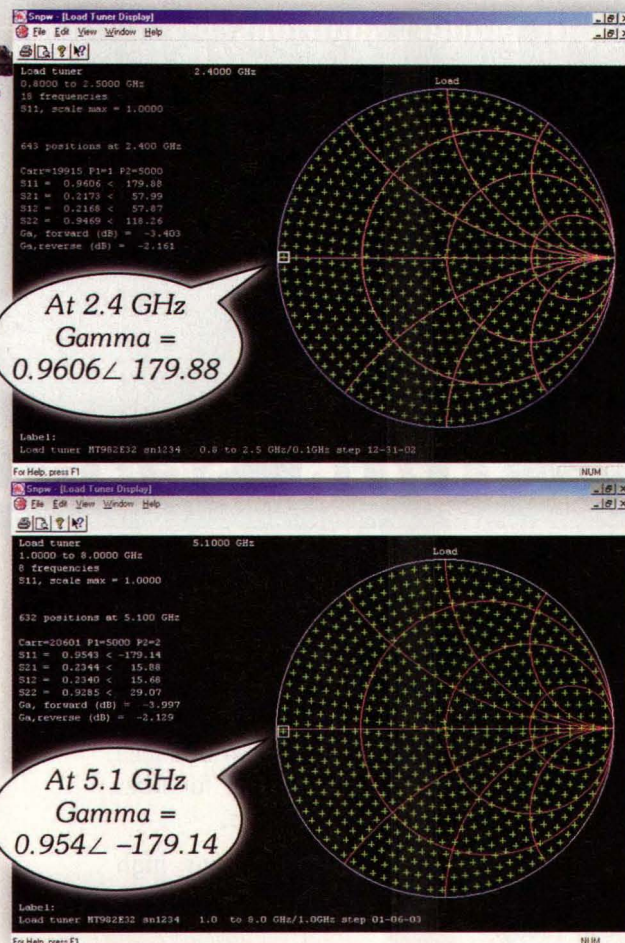
There has never been a better time to call MAURY for a complete measurement solution; mechanical, solid state, or multi-mode.



MAURY MICROWAVE
CORPORATION

www.maurymw.com

MAURY Automated Tuner Systems are Optimized for WLAN Applications in On-Wafer Environments



Agilent Technologies

Channel Partner

For RF Device
Measurement Solutions

the front end

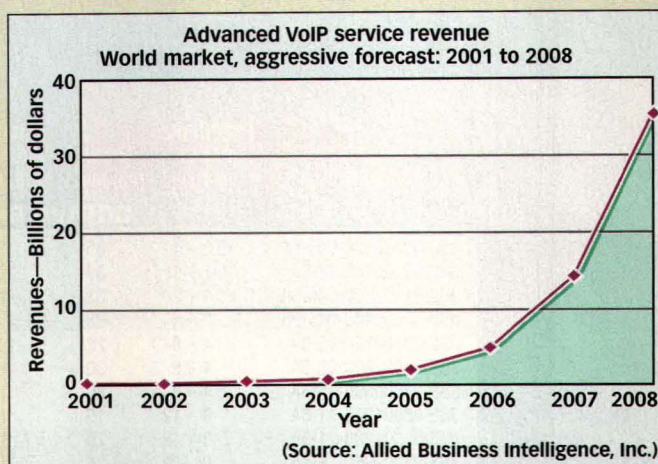
News items from the communications arena.

Market For Hosted VoIP Services To Reach \$36.5 Billion In 2008

OYSTER BAY, NY—Telecom carriers have been offering hosted voice services, like IP Centrex, based on circuit-switched gear, for years. Markets for such services have remained steady, but small due to limited feature sets and geographical dependence on the local central office (CO). Offering services based on next-generation Internet-protocol (IP) voice technology removes a number of these limitations, and typical architectures are inherently well suited to the hosted model due to their distributed nature.

While general availability of many IP voice offers to date have been limited, the combined worldwide revenues for hosted VoIP services, including IP-PBX, videoconferencing, contact center, and unified communications are expected to grow from \$46 million in 2001 to \$36.5 billion in 2008 (see figure), according to the findings in a report from Allied Business Intelligence, Inc. (ABI).

ABI's report, "Advanced IP Voice Services, Market Forecasts and Trends for VoIP-based Services: IP-PBX, Videoconferencing, Contact Center and Unified Communications," examines the types of advanced VoIP services that are emerging, and the profiles of customers who are adopting them. The report provides an overview of vendor offerings, with analysis of market trends and forecasts. Services addressed include IP-PBX, conferencing, contact centers, and unified communications.



Ansoft Corp.'s Dr. Zoltan Cendes Is Elected IEEE Fellow

PITTSBURGH, PA—Ansoft Corp. announced that Dr. Zoltan Cendes, the company's founder, chairman, and chief technology officer, was recently elected an Institute of Electrical and Electronics Engineers (IEEE) Fellow for his outstanding contributions to the application of finite-element modeling to microwave guides, structures, and circuits.

Dr. Cendes was the first microwave engineer to develop the finite-element technique using edge elements in the solution of the vector-wave equation. His early accomplishments led to the development of HFSS™, the industry-standard high-frequency tool for 3D electromagnetic-based design.

"It's wonderful to see this honor bestowed

upon Zol," said Nick Csendes, Ansoft's president and CEO. "His dedication to finite-element analysis has made him a pioneer in the field of high-frequency electromagnetics; and his commitment, technical expertise, and visionary outlook over the years have made Ansoft the leader it is today."

Dr. Cendes has been responsible for Ansoft's product and technology research and for the overall direction of the company's software since he founded the corporation in 1984. In addition to his responsibilities at Ansoft, Dr. Cendes is also an adjunct professor of electrical and computer engineering at Carnegie Mellon University in Pittsburgh, where he served as both an associate professor and professor for 14 years. He received his master's and doctoral degrees in Electrical Engineering from McGill University in Montreal, Canada.

Ultra-Low Noise AMPLIFIERS

VHF To V-BAND

MODEL NUMBER	FREQUENCY RANGE (GHz)	GAIN (dB, Min.)	GAIN VARIATION (±dB, Max.)	NOISE FIGURE (dB, Max.)	VSWR		POWER OUT @ 1 dB COMP. (dBm, Min.)	DC POWER @ +15 V (mA, Nom.)
OCTAVE BAND AMPLIFIERS								
JS2-00500100-045-5A	0.5 – 1	35	1	0.45	2:1	2:1	5	250
JS2-00500100-12-5A	0.5 – 1	35	1.2	1	2:1	2:1	5	250
JS2-01000200-045-5A	1 – 2	33	1	0.45	2:1	2:1	5	250
JS2-02000400-045-5A	2 – 4	28	1.2	0.45	2:1	2:1	5	175
JS2-04000800-08-0A	4 – 8	22	1.2	0.8	2:1	2:1	0	150
JS3-04000800-08-5A	4 – 8	30	1	0.8	2:1	2:1	5	175
JS3-04000800-15-5A	4 – 8	30	1	1.5	2:1	2:1	5	175
JS2-08001200-11-5A	8 – 12	15	1	1.1	2:1	2:1	5	150
JS3-08001200-11-5A	8 – 12	25	1	1.1	2:1	2:1	5	175
JS3-08001200-15-5A	8 – 12	25	1	1.5	2:1	2:1	5	175
JS3-12001800-16-5A	12 – 18	23	1	1.6	2:1	2:1	5	175
JS4-12001800-145-5A	12 – 18	30	1	1.45	2:1	2:1	5	200
JS4-12001800-30-5A	12 – 18	30	1	3	2:1	2:1	5	200
JS2-18002600-20-5A	18 – 26	14	2	2	2.5:1	2.5:1	5	100
JS2-18002600-30-5A	18 – 26	14	2	3	2.5:1	2.5:1	5	100
JS3-18002600-20-5A	18 – 26	22	1.8	2	2.5:1	2.5:1	5	175
JS3-18002600-30-5A	18 – 26	22	1.8	3	2.5:1	2.5:1	5	175
JS4-18002600-19-5A	18 – 26	33	1.5	1.9	2:1	2:1	5	200
JS4-18002600-26-5A	18 – 26	33	1.5	2.6	2:1	2:1	5	200
JS2-26004000-35-5A	26 – 40	10	2	3.5	2.5:1	2.5:1	5	100
JS2-26004000-45-5A	26 – 40	10	2	4.5	2.5:1	2.5:1	5	100
JS3-26004000-35-5A	26 – 40	18	2.5	3.5	2.5:1	2.5:1	5	175
JS3-26004000-45-5A	26 – 40	18	2.5	4.5	2.5:1	2.5:1	5	175
JS4-26004000-40-5A	26 – 40	23	2.5	4	2:1	2:1	5	200
JS4-40006000-65-0A	40 – 60	15	3	6.5	2.75:1	2.75:1	0	175
MULTIOCTAVE BAND AMPLIFIERS								
JS2-00500200-07-5A	0.5 – 2	32	1	0.7	2:1	2:1	5	295
JS2-00500200-15-5A	0.5 – 2	32	1	1.5	2:1	2:1	5	295
JS2-01000400-08-5A	1 – 4	27	1	0.8	2:1	2:1	5	200
JS2-01000400-20-5A	1 – 4	27	1	2	2:1	2:1	5	200
JS2-02000600-08-5A	2 – 6	22	1	0.8	2:1	2:1	5	125
JS2-02000600-20-5A	2 – 6	22	1	2	2:1	2:1	5	125
JS2-02000800-08-0A	2 – 8	22	1.25	0.8	2:1	2:1	0	125
JS2-02000800-20-0A	2 – 8	18	1.25	2	2:1	2:1	0	125
JS3-02001800-25-5A	2 – 18	23	1.8	2.5	2.5:1	2.5:1	5	150
JS3-02001800-50-5A	2 – 18	23	1.8	5	2.5:1	2.5:1	5	150
JS4-02001800-22-5A	2 – 18	30	2	2.2	2.5:1	2.5:1	5	200
JS4-02001800-50-5A	2 – 18	30	2	5	2.5:1	2.5:1	5	200
JS3-02002600-33-5A	2 – 26	21	2.5	3.3	2.5:1	2.5:1	5	150
JS3-02002600-40-5A	2 – 26	21	2.5	4	2.5:1	2.5:1	5	150
JS3-06001800-16-5A	6 – 18	23	1.8	1.6	2:1	2:1	5	125
JS3-06001800-30-5A	6 – 18	23	1.8	3	2:1	2:1	5	125
JS4-06001800-145-5A	6 – 18	31	2	1.45	2:1	2:1	5	200
JS4-06001800-30-5A	6 – 18	31	2	3	2:1	2:1	5	200



MITEQ's JS SERIES AMPLIFIERS

- High Performance/Price Ratio
- Superior, Rugged Technology
- Low Phase Distortion Design

Actual
18 to 40 GHz Design

MODEL NUMBER	FREQUENCY	GAIN	GAIN	NOISE	VSWR		POWER OUT	DC POWER
	RANGE (GHz)		VARIATION (dB, Min.) (±dB, Max.)	FIGURE (dB, Max.)	IN	OUT	@ 1 dB COMP. (dBm, Min.)	@ +15 V (mA, Nom.)
MULTIOCTAVE BAND AMPLIFIERS (continued)								
JS3-08001800-16-5A	8 – 18	24	1.5	1.6	2:1	2:1	5	150
JS3-08001800-30-5A	8 – 18	24	1.5	3	2:1	2:1	5	150
JS4-08001800-145-5A	8 – 18	32	2	1.45	2:1	2:1	5	200
JS4-08001800-30-5A	8 – 18	32	2	3	2:1	2:1	5	200
JS3-12002600-25-5A	12 – 26	22	2.5	2.5	2.2:1	2.2:1	5	150
JS3-12002600-35-5A	12 – 26	22	2.5	3.5	2.2:1	2.2:1	5	150
JS4-12002600-22-5A	12 – 26	32	2.2	2.2	2:1	2:1	5	200
JS4-12002600-35-5A	12 – 26	32	2.2	3.5	2:1	2:1	5	200
JS3-18004000-38-5A	18 – 40	16	2.5	3.8	2.5:1	2.5:1	5	150
JS3-18004000-50-5A	18 – 40	16	2.5	5	2.5:1	2.5:1	5	150
JS4-18004000-30-5A	18 – 40	23	2.5	3	2.5:1	2.5:1	5	200
JS4-18004000-50-5A	18 – 40	23	2.5	5	2.5:1	2.5:1	5	200
ULTRAWIDE BAND AMPLIFIERS								
JS2-00100200-07-5A	0.1 – 2	32	1	0.7	2:1	2:1	5	295
JS2-00100200-15-5A	0.1 – 2	32	1	1.5	2:1	2:1	5	295
JS2-00100400-08-5A	0.1 – 4	27	1	0.8	2:1	2:1	5	200
JS2-00100400-12-5A	0.1 – 4	27	1	1.2	2:1	2:1	5	200
JS2-00100600-10-3A	0.1 – 6	23	1.5	1	2:1	2:1	3	175
JS2-00100600-20-3A	0.1 – 6	23	1.5	2	2:1	2:1	3	175
JS2-00100800-13-0A	0.1 – 8	20	1.5	1.3	2:1	2:1	0	175
JS2-00100800-25-0A	0.1 – 8	20	1.5	2.5	2:1	2:1	0	175
JS3-00101000-20-5A	0.1 – 10	23	1.5	2.0	2.5:1	2:1	5	150
JS3-00101000-35-5A	0.1 – 10	23	1.5	3.5	2.5:1	2:1	5	150
JS3-00101200-21-5A	0.1 – 12	23	1.5	2.1	2.5:1	2:1	5	150
JS3-00101200-35-5A	0.1 – 12	23	1.5	3.5	2.5:1	2:1	5	150
JS3-00101800-24-5A	0.1 – 18	23	1.8	2.4	2.5:1	2.2:1	5	150
JS3-00101800-40-5A	0.1 – 18	23	1.8	4	2.5:1	2.2:1	5	150
JS4-00101800-23-5A	0.1 – 18	29	1.8	2.3	2.5:1	2.2:1	5	200
JS4-00101800-40-5A	0.1 – 18	29	1.8	4	2.5:1	2.2:1	5	200
JS4-00102000-25-5A	0.1 – 20	28	1.8	2.5	2.5:1	2.5:1	5	200
JS4-00102000-35-5A	0.1 – 20	28	1.8	3.5	2.5:1	2.5:1	5	200
JS3-00102600-33-5A	0.1 – 26	20	2.5	3.3	2.5:1	2.5:1	5	150
JS3-00102600-42-5A	0.1 – 26	20	2.5	4.2	2.5:1	2.5:1	5	150
JS4-00102600-28-5A	0.1 – 26	27	2.5	2.8	2.5:1	2.5:1	5	200
JS4-00102600-50-5A	0.1 – 26	27	2.5	5	2.5:1	2.5:1	5	200
JS4-00104000-65-5A	0.1 – 40	14	4.5	6.5	2.75:1	2.75:1	5	200
JS4-00104000-85-5A	0.1 – 40	14	4.5	8.5	2.75:1	2.75:1	5	200

For additional information or technical support, please contact either
Rosalie DeSousa at (631) 439-9458, e-mail rdesousa@miteq.com or
Rizwan Syed at (631) 439-9267, e-mail rsyed@miteq.com



100 Davids Drive, Hauppauge, NY 11788
TEL.: (631) 436-7400 • FAX: (631) 436-7430

www.miteq.com

Contract For \$2.3M Is Signed To Support Satellite System

NORTHAMPTON, MA—Millitech, LLC has received a phase-two contract for \$2.3 million from Boeing Satellite Systems to supply millimeter-wave receivers (Rxs) in support of the Conical Microwave Image Sounder (CMIS) program. The CMIS contract includes up to 12 years of options, which could double the value of the order, to supply flight hardware for the National Polar-Orbiting Operational Environmental Satellite System (NPOESS).

NPOESS is the next-generation, low-earth-orbit environmental satellite system that will save the US Government approximately \$1.8 billion by converging existing systems operated by the Department of Defense (DoD) and the National Oceanic Atmospheric Administration (NOAA). CMIS is one of the weather instruments included on six NPOESS satellites. The first CMIS instrument is scheduled for delivery by 2005 with the second to be delivered by 2007. The first NPOESS satellite is scheduled to be available for launch in 2009.

"This continues Millitech's 20-year history of supporting flight hardware for satellite applications," said Bill Hanley, president and CEO of Millitech, LLC. "We are very excited to contribute to the state-of-the-art technology that will be launched on the CMIS program. This award complements our diverse base of microwave and millimeter-wave work that includes radar, satellite communications, environmental sensing, and remote space-based sensing."

The CMIS sensor consists of three different subsystems: antennas, receivers, and data handling. The antennas gather microwave energy from the earth's geological landscape. The receivers divide the microwaves into numerous specific channels and measure the "brightness" of the earth within each channel. The data-handling subsystem formats the sensor data and other critical information for transmission to the ground where algorithms turn the data into weather information such as maps of ocean temperature, wind speed, and snow cover.

The initial funding for this system was a \$750,000 proof-of-concept and design effort that was successfully completed last year by the company's engineering group at the corporate headquarters in Northampton, MA. The further development and manufacturing of the system will be done at the same facility.

Ottawa Fire Dept. Improves Radio Communications

LOWELL, MA—M/A-COM, Inc., a unit of Tyco Electronics and manufacturer of critical radio systems deployed around the world, was awarded a \$2.75 million (US) contract from the City of Ottawa (Canada) to implement the Fire Department's new Console Dispatch System and to purchase new radios. These new units will be added to the existing City of Ottawa-owned 800-MHz EDACS (Enhanced Digital Access Communications System) trunked radio system. Already used by the City of Ottawa Police and all other City Departments (including EMS), EDACS serves as the backbone of the city's radio-communications network and provides coverage of the city's 1000-square-mile geographical area.

"The Ottawa Police and Public Works Department have used M/A-COM's EDACS system for years with complete satisfaction," said Don McCallan, division chief of communications for the Ottawa Fire Department. "As a result, it was a logical choice for us to deploy the same system for performance and interoperability with other departments. We are confident that M/A-COM's EDACS system will provide the same reliable, effective communications that the other departments have experienced."

The EDACS system has the capabilities to support both current and future public-safety radio needs. In selecting a radio network, the Ottawa Fire Department desired a system that would not only enhance communications for public safety, but one that would also connect with all citywide departments.

The expanded M/A-COM trunked radio system will ensure mobile and portable communications for police officers and firefighters, as well as other city personnel who provide essential services to the public, such as street maintenance and utility services. The system will unite over 4000 users within the citywide departments and will support portable, on-the-street coverage for an area of the city's entire geographical area. As part of the agreement, M/A-COM will provide, assemble, and integrate all of the project's hardware and software as well as provide both user and administrative training.

"M/A-COM is looking forward to expanding the EDACS communications network for citizens and public-safety community of Ottawa," said Bill Hall, M/A-COM's account manager.

The EDACS system has the capabilities to support both current and future public-safety radio needs."



DC-6GHz ATTENUATORS ^{\$9.95} from ea. (qty. 1-9)

Mini-Circuits VAT and HAT fixed attenuators rank at the top of their class for high performance, big selection, and low cost! Choose from 14 different attenuation values; from 1 to 10dB in 1dB steps plus 12, 15, 20, and 30dB. All in stock, ready for immediate shipment, and *value priced* from only \$9.95 for BNC (HAT) and \$11.95 for SMA (VAT). Performance wise, these devices offer excellent attenuation flatness, low VSWR, and handle up to 500mW input power. Plus, rugged unibody construction makes them very easy to use in systems, testing, and product development applications. So get the best economy from your design with Mini-Circuits fixed attenuators.

Mini-Circuits...we're redefining what VALUE is all about!

Models		Attenuation* (dB)				VSWR (:1)	
SMA-M/F DC-6GHz	BNC-M/F DC-2GHz	Nominal	Flatness Midband Typ.	Flatness Midband Typ.	Flatness Midband Typ.	Midband Typ.	Midband Typ.
VAT-1	HAT-1	1	1	0.20	0.11	1.10	1.2
VAT-2	HAT-2	2	2	0.20	0.10	1.20	1.2
VAT-3	HAT-3	3	3	0.15	0.12	1.15	1.1
VAT-4	HAT-4	4	4	0.15	0.08	1.15	1.1
VAT-5	HAT-5	5	5	0.10	0.06	1.15	1.1
VAT-6	HAT-6	6	6	0.10	0.02	1.15	1.1
VAT-7	HAT-7	7	7	0.10	0.05	1.15	1.1
VAT-8	HAT-8	8	8	0.10	0.04	1.20	1.1
VAT-9	HAT-9	9	9	0.10	0.02	1.15	1.1
VAT-10	HAT-10	10	10	0.20	0.03	1.20	1.1
VAT-12	HAT-12	12	12	0.10	0.05	1.20	1.1
VAT-15	HAT-15	15	15	0.30	0.05	1.40	1.1
VAT-20	HAT-20	20	20	0.75	0.18	1.20	1.1
VAT-30	HAT-30	30	30	0.30	0.38	1.15	1.1

Power: 0.5W at 70°C ambient.

* Attenuation varies by ± 0.3 dB max. (VAT), ± 0.2 dB max. (HAT) over temperature.

•VAT MODELS \$11.95 ea. (qty. 1-9) •HAT MODELS \$9.95 ea. (qty. 1-9)

ALL MODELS IN STOCK

DESIGNER'S KITS AVAILABLE

K1-VAT: 1 of Ea. VAT-3, -6, -10, -20, -30 (5 total) \$49.95

K2-VAT: 1 of Ea. VAT-1, -2, -3, -4, -5, -6, -7, -8, -9, -10 (10 total) \$99.95

K3-VAT: 2 of Ea. VAT-3, -6, -10 (6 total) \$59.95

K1-HAT: 1 of Ea. HAT-3, -6, -10, -20, -30 (5 total) \$48.95

K2-HAT: 1 of Ea. HAT-1, -2, -3, -4, -5, -6, -7, -8, -9, -10 (10 total) \$97.95

K3-HAT: 2 of Ea. HAT-3, -6, -10 (6 total) \$58.95



P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

ISO 9001 CERTIFIED

F 363 Rev 08

Attractive Cost Of 802.11b Drove Wi-Fi Shipments In 2002

SCOTTSDALE, AZ—The year 2002 proved to be stellar for wireless-local-area-network (WLAN) volume growth driven by increasingly cheap and reliable 802.11b technology, according to the high-tech market-research firm, In-Stat/MDR. The research firm reports that business Wi-Fi shipments are expected to rise 65 percent annually in 2002, to 11.6 million units and home shipments are expected to increase by a very healthy 160 percent, to 6.8 million units. However, fast and furiously falling prices for 802.11b equipment are expected to cause total market revenues to grow by only 23 percent, from \$1.8 billion in 2001 to \$2.2 billion in 2002.

“In 2002, security continued to be the most talked-about issue on the business side, while the Achilles heel of the home market remained multimedia support,” said Gemma Paulo, a senior analyst with In-Stat/MDR. “In the year ahead, the continued growth and evolution of dual-mode 2.4/5-GHz capable equipment, Intel’s ability to push out its Centrino mobile technology, the shift toward 802.11g as the preferred 2.4-GHz WLAN technology, and the Advent of new enterprise infrastructure technology, will all shape the development of this market.”

In-Stat/MDR’s report, “It’s Cheap and It Works: Wi-Fi Brings Wireless Networking to the Masses,” includes five-year forecasts of the worldwide total WLAN equipment market, including Wi-Fi equipment, i.e., 802.11b, 802.11a, 802.11g, and dual-band 2.4/5-GHz products. Business and home/SOHO (small office, home office) Wi-Fi market forecasts are included, by technology and equipment type. In-Stat/MDR believes that the market’s main measurable components include network-interface cards (NICs) and infrastructure equipment, which includes access points and bridges. This report gauges the size of the current market, and provides forecasts for the future, based on products shipped and end-use sales of these three product components.

Kudos

TEMPE, AZ—Motorola Labs has been named by *Scientific American* magazine as one of the “Scientific American 50”—the magazine’s first list recognizing contributions during 2002 to

science and technology providing a vision of a better future.

Motorola Labs was named Leader in the Chemicals and Materials category for its work on developing new semiconductor materials, particularly research related to layering compound semiconductor materials on silicon.

SAN DIEGO, CA—QUALCOMM, Inc. announced that two high school students—Chris Castello, a sophomore at Helix Charter High School, and Dorian Mattrey, a sophomore at La Jolla High School—are the winners of QUALCOMM’s “Wireless Technology Touchdown” contest. The contest called for creative ideas on how wireless technology can enhance the sport of football and/or the spectator experience. Winners each received two tickets to Super Bowl XXXVII, which was held on January 26 at QUALCOMM Stadium in San Diego, as well as a \$5000 academic scholarship toward their college education. QUALCOMM also donated \$10,000 to the math and science departments at the winners’ schools.

Castello’s winning submission included a handheld device to assist in seat and facility location within the stadium, connecting to the snack bar, enabling people to order snacks from their seats and check football statistics or coaching strategies during the game.

Mattrey recommended development of a new handheld technology combined with a helmet camera to allow stadium fans greater interaction with the game.

CHELMSFORD, MA—In 2002, Hittite continued to build their standard product portfolio with the release of 50 new RF IC/MMICs covering applications from DC to 42 GHz.

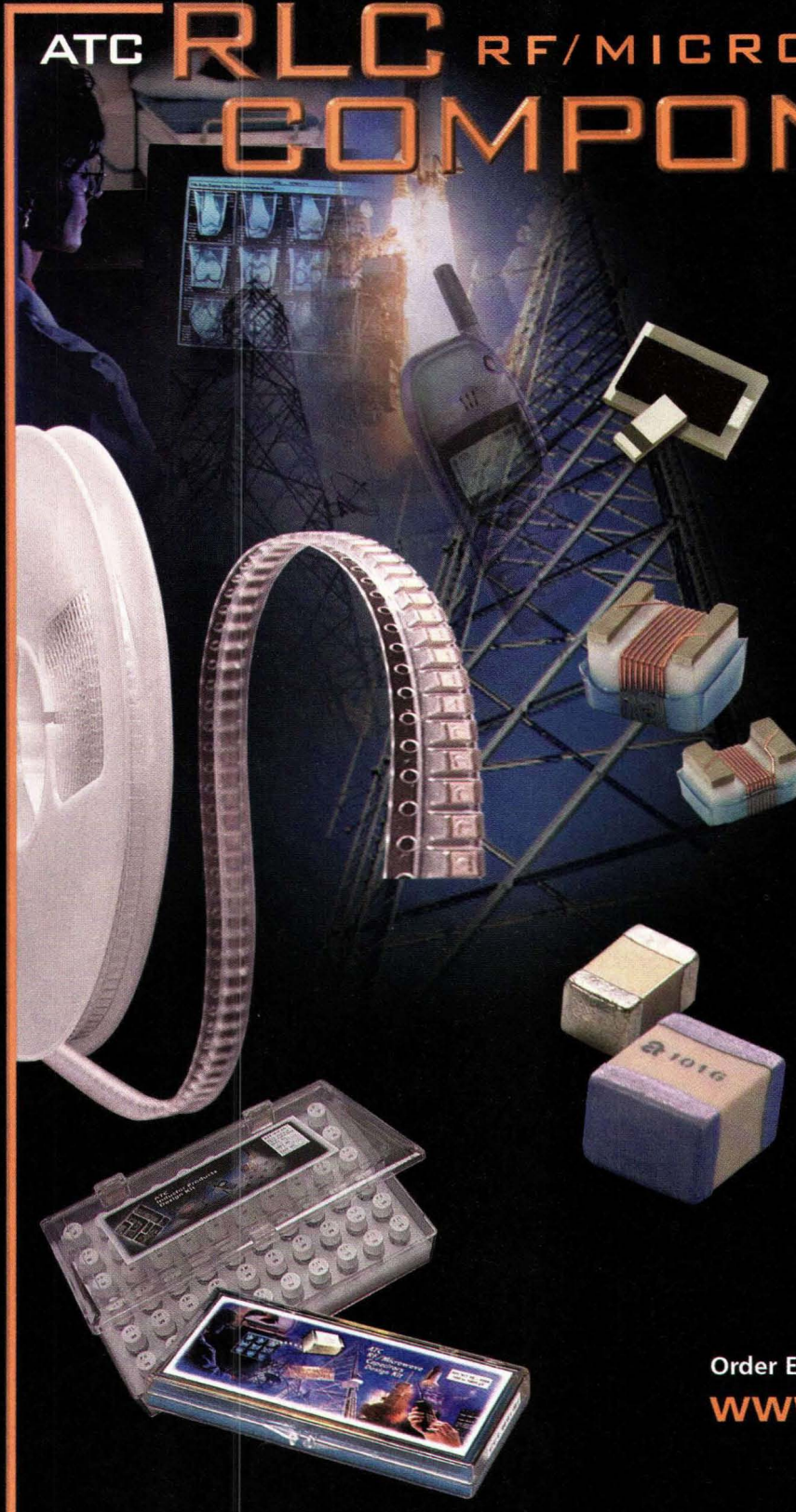
Notable additions for cellular/3G and broadband systems include: +36-dBm IIP3 mixers; +45-dBm OIP3 amplifiers; broadband gain blocks to 10 GHz; a low-phase-noise 2-GHz VCO; low-distortion +65-dBm IIP3 switches; 5.2-GHz WLAN diversity switches; and >55-dB isolation switches for LO multiplexing and CATV.

SANTA ANA, CA—Calmont Wire & Cable, Inc. was recently awarded a commemorative plaque from DuPont. The plaque reads: “In recognition of the innovative and dedication of Calmont Wire & Cable in manufacturing high-quality products with superior performance using DuPont’s™ TEFZEL fluoropolymer resin.”

DuPont recognizes Calmont’s capability in the utilization of Tefzel® and Aracon® in a cable construction offering exceptional properties and benefits. **MRF**

“In 2002, security continued to be the most talked-about issue on the business side, while the Achilles heel of the home market remained multimedia support.”

ATC RLC RF/MICROWAVE COMPONENTS



Resistive Products

- Aluminum Nitride Based Substrates
- Low VSWR (Terminations)
- Low Capacitance (Resistors)
- DC to 18 GHz

Inductor Products

- High Q, High SRF, Low DC Resistance
- 1 nH to 4700 nH
- Traditional EIA Sizes
- Ceramic Core, Wire Wound Construction

Capacitor Products

- High Q, High Reliability (QPL)
- Low ESR / ESL
- Ultra-stable Performance
- Rugged Construction

Order Engineering Design Kits online at:
www.atceramics.com




THE
ENGINEERS'
CHOICE™

AMERICAN TECHNICAL CERAMICS
COMPONENT AND CUSTOM INTEGRATED PACKAGING SOLUTIONS
FOR RF, MICROWAVE AND TELECOMMUNICATIONS

ATC North America
631-622-4700
sales@atceramics.com

ATC Europe
+46 8 6800410
sales@atceramics-europe.com

ATC Asia
86 755 8399 5205
sales@atceramics-asia.com

 WORLD'S WIDEST SELECTION

VCOs

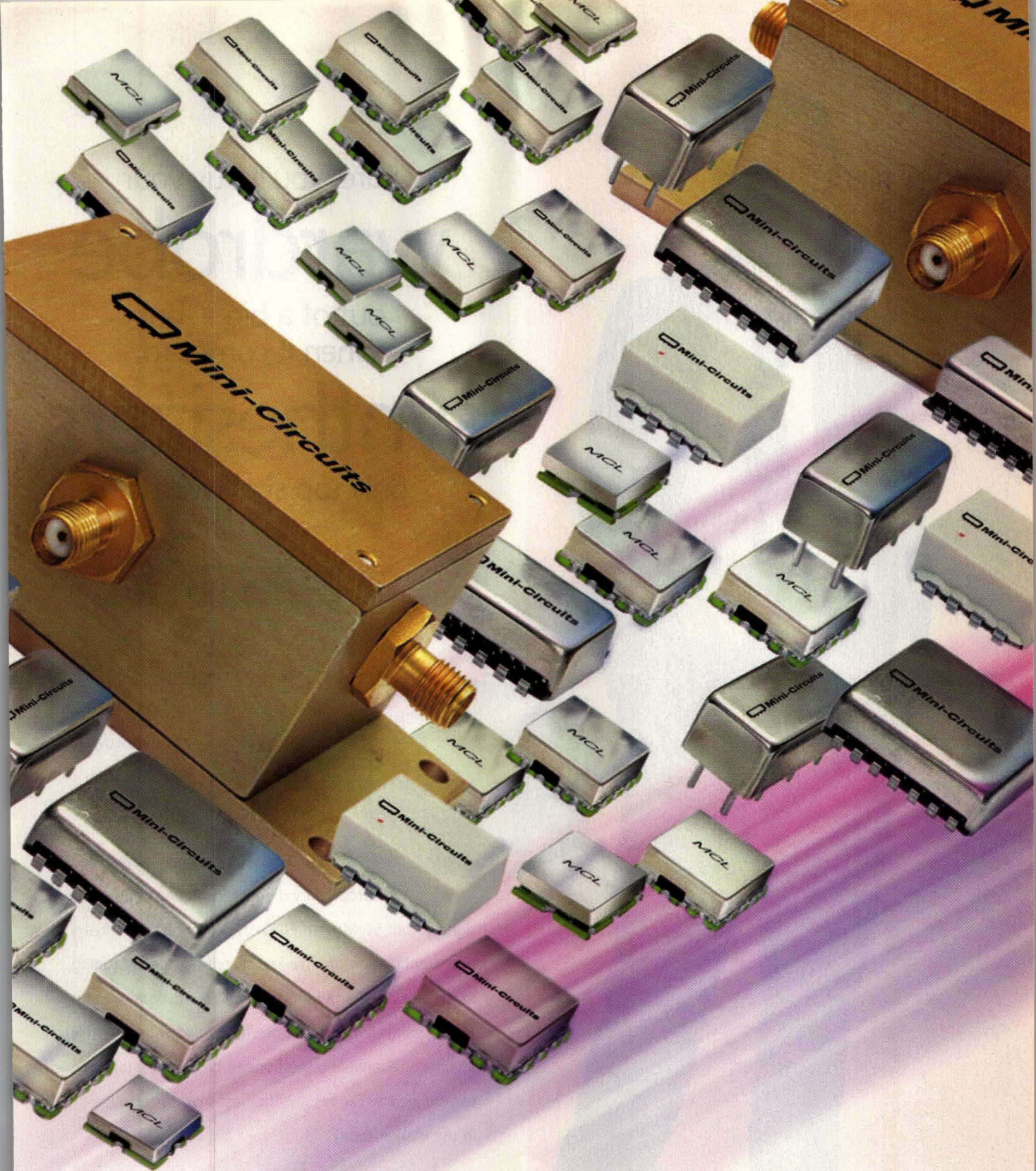
12.5 to 4000MHz from \$11⁹⁵
ea. (qty. 5)

Want a miniature surface mount, shielded plug-in, or rugged coaxial voltage controlled oscillator with the right stuff for your project? Contact Mini-Circuits! From custom designs to standard catalog models **always in stock**, we'll supply extra robust, 100% tested VCO solutions you need at a price you can afford. Choose from narrow to broad to octave band widths. Select linear tuning, low phase noise, and 5V models optimized for PLLs and synthesizers. And pick from an innovative array of miniature SM packages as small as 0.370" square for a variety of designs and applications. You can quickly find the model you need using "The YONI Search Engine" at the Mini-Circuits web site. Just enter your specs...click...and immediately start evaluating suggested VCO solutions using the *actual measured performance data* displayed. But perhaps you need a custom design. Not a problem! Contact us for our lightning fast response, low prices, and quick turnaround. Give the competition *real competition*...specify Mini-Circuits VCOs!

New VCO Handbook...FREE!

Mini-Circuits...we're redefining what VALUE is all about!





P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

ISO 9001 ISO 14001 CERTIFIED

341 Rev. B



Sure, you'll buy your
wardrobe
out of a bin—but
when it comes to
synthesizers,
only top shelf will do.

WaveCor[™]



For the important things—like clean, pure, fast signals—only the best will do. That's why you should know about WaveCor Synthesizers from ITT Microwave Systems.

WaveCor Synthesizers use advanced proprietary digital techniques to produce signals from 50 MHz to 20 GHz, delivering the industry's best combination of ultra-fast switching, precise tuning, low phase noise and high spurious free dynamic range. This unparalleled performance is coupled with a flexible architecture, enabling solutions to be precisely tailored to your needs. The result? The best synthesizer value in the market today.

So dress up your next design with a WaveCor Synthesizer. They can make anybody look good—even this guy.



ITT Industries
Microwave Systems
Engineered for life

978-441-0200 • www.ittmicrowave.com

DSPs And Data Converters Enable Complex Modulation

Some of the latest processors and converters provide the muscle to support the wide bandwidths and multiple-carrier capabilities of emerging cellular-infrastructure equipment.

microwave and RF engineers have become more familiar with data converters and digital signal processors (DSPs) in recent years. These components are now mainstays in many wireless systems, making possible the complex filtering and algorithms employed in digital modulation schemes and multichannel communications architectures. In essence, analog-to-digital converters (ADCs) sample

analog input signals, digital-to-analog converters (DACs) generate complex modulated waveforms for signal transmission, and DSPs provide the sophisticated filtering and signal manipulation in between the two converter types.

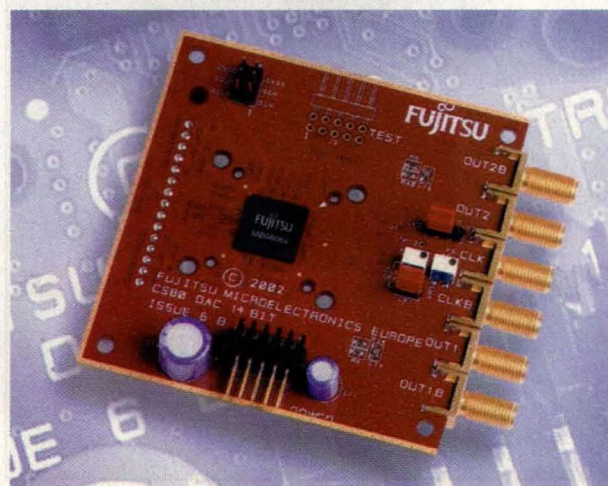
The general trend for ADCs, DACs, and DSPs is one of increased processing power at lower power-consumption levels. The recently introduced (see *Microwaves & RF*, February 2003, p.

118) TMS320VC5501 and TMS320VC5502 DSPs from Texas Instruments (Dallas, TX, www.ti.com) have dual

multiply-and-accumulate (MAC) cores and 300-MHz clock speeds for prices starting at \$5. These LQPF-packaged devices consume only 200-mW power during normal operation.

The company also recently announced a series of new processors for Universal Mobile Telecommunications System (UMTS) applications, in accordance with the new Open Mobile Application Processor Interface (OMAPI)

JACK BROWNE
Publisher/Editor



Shown here on a test board, the model MB86064 dual 14-b DAC provides 800-MSamples/s sampling rate in support of carrier generation of GSM, WCDMA, and UMTS systems. (Photograph courtesy of Fujitsu Microelectronics, San Jose, CA.)

standard (which is comprised of a set of software interfaces to the operating system and a set of hardware interfaces defining common application peripheral devices). These OMAP1 processors combine a DSP and a high-speed microcontroller on a single chip. Based

on a 0.13- μ m complementary-metal-oxide-semiconductor (CMOS) process, the OMAP1612 processor, for example, combines the company's TMS320C55x DSP core (capable of operation to 204 MHz) with an ARM926TEJ processor core (also capa-

ble of operation to 204 MHz). The OMAP1612 is available with 128 to 256 Mb of stacked mobile double-data-rate (DDR) synchronous-dynamic-random-access memory (SDRAM) to help reduce the size of cellular handsets and Personal Digital Assistants (PDAs) while also lending the processing power for wireless streaming-video and multimedia applications. The OMAP1612 offers a dedicated connection to the company's TNETW1130 wireless-local-area-network (WLAN) processor to simplify the interface with 54-Mb/s WLAN circuitry.

Texas Instruments recently established new standards in terms of processing speed with their 720-MHz models TMS320C6414, TMS320C6415, and TMS320C6416 DSPs. All three devices include 1 MB of on-chip memory with differences in peripheral support and inclusion of coprocessors (such as the integral Viterbi and Turbo coprocessors on the TMS320C6416). These high-speed DSPs are well suited for digital video, imaging, and wireless communications applications. (Note that more information on these three new devices is available by logging directly onto the company's website at www.ti.com/720mhsp.)

One of the earlier developers of DSP technology (as Lucent Technologies), Agere Systems (Allentown, PA, www.agere.com) entered the marketplace for dual-MAC DSPs with its model DSP16411. Operating at maximum clock rates to 285 MHz, the DSP is optimized for use with communications infrastructure equipment. In addition to its enhanced direct-memory-access (DMA) capabilities, the DSP features an on-chip programmable PLL clock synthesizer to eliminate the need for a high-speed clock input. It is designed for use with a single +3.3 VDC.

In addition to Motorola (Phoenix, AZ) as a supplier of DSPs, it should be noted that some suppliers of field-programmable gate arrays (FPGAs), including Altera Corp. (San Jose, CA) and Xilinx, Inc. (San Jose, CA), promote the use of their ICs for DSP functionality. For example, Altera's Stratix line



The Wait Is Over!

MECA ELECTRONICS
INTRODUCES
e-meca.com

Attenuators, Couplers, Power Dividers and Terminations
On-Line Convenience
Shipped The Next Business Day
Guaranteed

Premium microwave components
since 1961

MECA

MECA Electronics, Inc.
459 East Main Street
Denville, NJ 07834-2515
Tel: (973) 625-0661
Fax: (973) 625-1258
e-mail: sales@e-meca.com

VISA® MasterCard® AMERICAN EXPRESS®

Visa, MasterCard
and American Express accepted.
Security assured by Verisign.

Dozens of standard items,
in stock, ready to ship.

**SUPER FAST
VERY HIGH ISOLATION**

SWITCHES



\$195*
SPDT, DC-5GHz From ea. (10,000) **IN STOCK**

Very high isolation up to 90dB at 1GHz typical. Built-in TTL driver with blazing fast 10nsec switching speed. The ability to withstand severe operating temperatures down to -40°C to +85°C. That's what's great about Mini-Circuits wideband surface mount and coaxial SPDT switches. But that's not all! Reflective and absorptive models are available in three different package styles to suite your design requirements; M3SW's 3x3mm MCLP™ surface mount package with exposed metal bottom for excellent grounding and heat dissipation, SWM's SOIC-8 for easier assembly, and ZASW's tough built coaxial design with SMA-F connectors. No matter which model you choose, you'll get strong performance and rugged reliability at a price that crushes the competition. Check all the specs on our web site, then contact Mini-Circuits for our fast response!

Mini-Circuits...we're redefining what VALUE is all about!



ZASW-2-50DR
ZASWA-2-50DR

SPECIFICATIONS (@ 1GHz)

Model	Freq. (GHz)	In-Out Isol. dB(typ)	Ins. Loss dB(typ)	1dB Comp. dBm(typ)	Price \$ea. (Qty. 10)
• M3SW-2-50DR	DC-4.5	60	0.7	25	4.95 *
■ M3SWA-2-50DR	DC-4.5	65	0.7	25	4.95 *
• SWM-2-50DR	DC-4.5	55	0.7	25	5.30
■ SWMA-2-50DR	DC-4.5	65	0.7	25	5.30
• ZASW-2-50DR	DC-5	90	1.7	20	79.95
■ ZASWA-2-50DR	DC-5	90	1.7	20	79.95

Supply voltage +5V, -5V. TTL control.
Switching time 10nsec (typ).

• Reflective ■ Absorptive

ACTUAL SIZE



SOIC-8 3x3mm
Mini-Circuits
Low Profile (MCLP™)

Detailed Performance Data & Specs Online at: www.minicircuits.com/model

Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

ISO 9001 ISO 14001 CERTIFIED

379 Rev F

See our 244 page RF/IF Designer's Guide in EEM (Electronic Engineers Master)

of FPGAs includes the embedded memory, embedded processors, and DSP blocks needed for high-speed DSP. The Stratix devices can provide 16×16 multiply operations at 270 MHz, for example.

At the recent Wireless Systems Design Conference & Expo (San Jose, CA), Fujitsu Microelectronics (San Jose, CA) announced their model MB86064 dual 14-b DAC for generation of carrier signals in Global System for Mobile Communications (GSM), wireless-code-division-multiple-access (WCDMA), and UMTS systems (see figure). The 800-MSamples/s device supports the wide channel bandwidths of these emerging wireless systems. Fabricated with a 0.18- μ m CMOS process, the presence of two DACs within a common package supports diversity-transmit or dual-transmit applications as well as high-speed test equipment.

Analog Devices (Wilmington, MA,

The general trend for ADCs, DACs, and DSPs is one of increased processing power at lower power-consumption levels.

www.analog.com) also made a strong showing at the Wireless Systems Design Conference & Expo with a number of new ICs. For example, the company recently launched a high-speed ADC as well as a DAC, both nominally for cellular applications. The ADC is the 14-b, 80-MSamples/s model AD9245 that consumes less than 500 mW power from a single +3-VDC supply. Available in a 32-pin chip-scale package (CSP), the ADC is ideal for microcells and pic-

ocells requiring low power consumption. The converter operates at 80 MSamples/s and supports input frequencies to 100 MHz. It uses a multi-stage differential pipelined architecture with output error-correction logic to provide 14-b accuracy over a wide temperature range. It features a signal-to-noise ratio of 72 dB and spurious-free dynamic range (SPDR) of -85 dBc. The converter includes a sample-and-hold (S/H) amplifier with a proprietary input sampling network that can be configured for single-ended or differential operation.

The DAC is the model AD9786, a 16-b, 400 MSamples/s CMOS device that allows synthesis of signals at IFs of 140 MHz and higher. Ideal for multicarrier base stations, the DAC offers a noise floor of -163 dBm/Hz and $2 \times 4 \times 8 \times$ selectable interpolation filters at a data rate of 160 MSamples/s. The DAC achieves IMD performance of better



Skyworks Solutions, Inc. is the world's largest company focused exclusively on wireless semiconductor solutions for handsets, infrastructure and WLAN applications. New products are continually being introduced at Skyworks. Visit our web site at www.skyworksinc.com, email us at sales@skyworksinc.com or call 781.376.3000.

than -80 dBc to 300 MHz and SFDR of -90 dBc at 10 MHz.

For sampling applications at slightly less bit resolution, the firm's model AD12400 ADC offers 12-b resolution at 400 MSamples/s. suitable for both military radars and multichannel communications systems, the ADC achieves a SFDR of -75 dBc at 128 MHz and a SNR of 64 dB at the same carrier frequency. Supplied as a packaged module, the ADC features a transformer-coupled analog input and digital processing to achieve the wide dynamic range.

The company also unveiled several highly integrated solutions for wireless applications, including the models AD6635 and AD6652, multiple-channel radio receiver (Rx) processors. The AD6635, for example, is an eight-channel receive-signal processor (RSP) that is capable of processing as many as four cdma2000 or WCDMA channels or eight narrowband GSM or EDGE car-

riers simultaneously. It has four reconfigurable 80-MSamples/s RSP input channels and eight independent RSP shared-channel resources. The AD6652 is an integrated radio Rx with dual ADCs and RSPs. It is essentially a mixed-signal IF-to-baseband Rx that directly couples outputs from the dual 12-b ADCs to an on-board quad-channel multimode digital RSP. The company explains the RSP as a numeric preprocessor for a DSP, intended to replace the local oscillator (LO), quadrature mixer, channel-select filter, and data decimation found in a traditional super-heterodyne radio architecture.

In terms of pure speed, the MAX108 ADC from Maxim Integrated Products (Sunnyvale, CA) manages 8-b resolution at 1.5 GSamples/s while supporting input bandwidths to 2.2 GHz. Designed for single-ended or differential use, the bipolar device is designed for ± 5 -VDC supplies and has an effective

input signal range of ± 250 mV. The company's MAX104 offers the same input bandwidth and 8-b resolution, but at a maximum sampling rate of 1 GSamples/s (see *Microwaves & RF*, March 1999, p. 128). Both ADCs benefit from a bipolar process capable of fabricating NPN transistors with transition frequencies in excess of 27 GHz.

Recently, the company introduced the MAX5888 DAC for multicarrier cellular base stations (see *Microwaves & RF*, November 2002, p. 95). Designed to generate as many as four UMTS carriers at bandwidths to 100 MHz, the 16-b DAC features a 500-Msamples/s update rate. The SFDR for the MAX5888 is typically -76 dBc when generating a 40-MHz output signal. The DAC dissipates less than 250 mW from a single +3.3-VDC supply. It provides a signal-to-noise ratio (SNR) of -155 dBc and two-tone IMD of -72 dBc for an 80-MHz output frequency. **MRF**



Visit us at CTIA
Booth #3667

KEY PRODUCTS:

Switches | Power Amplifiers

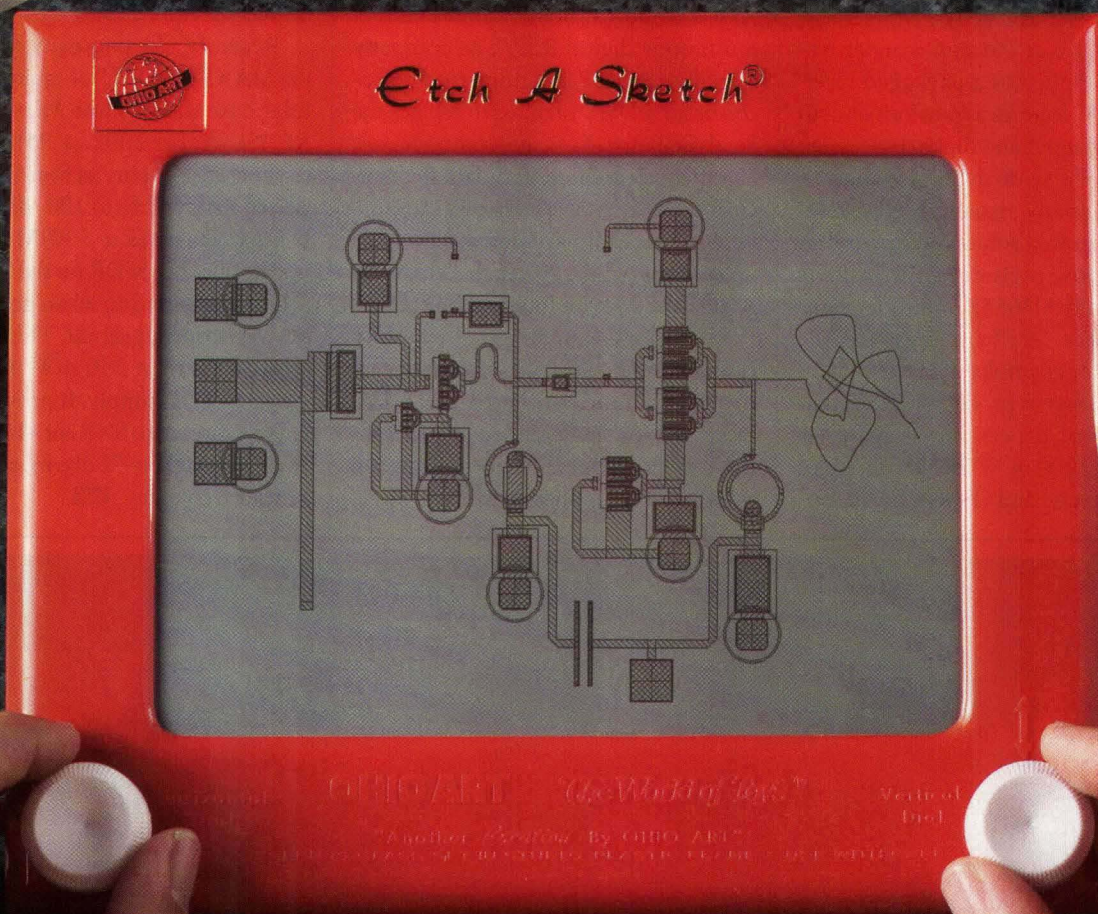
Discrete Semiconductors | RF TX Modules | Direct Conversion Transceivers

Single Package Radio™ Solutions | Complete 2.5G Systems

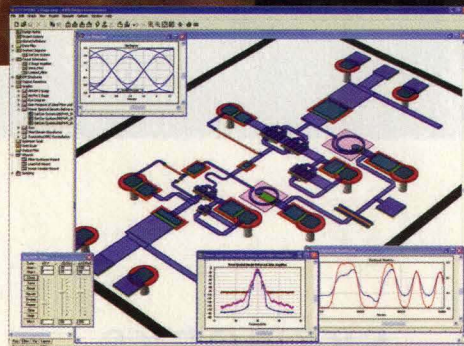
www.skyworksinc.com



SKYWORKS™
BREAKTHROUGH SIMPLICITY



Still doing tomorrow's designs with yesterday's layout tools?



Are you toying around with outdated layout tools that make you anything but agile? Have you considered switching to Microwave Office™ 2002? It was designed from the ground up to support complex layout problems like LTCCs, MMICs and RFICs, not to mention dense PCBs—with advanced capabilities like design rule checking, 3D views, and the industry's only truly unified database. Which means you'll never have to deal with those problematic design synchronization steps or back annotations that can ruin your

day. It also comes with manufacturing interfaces like Gerber, DXF and GDSII that actually work! Stop playing around, and start getting your designs out in no time flat. Make the switch to Microwave Office 2002. Download a 30-day evaluation from www.mwoffice.com or call us at 310-726-3000 for more information.



"So, this is how they phoned home!"

"No wonder, It uses a PAM made by EiC!"

PIONEERING

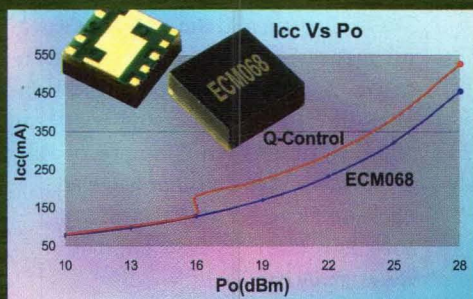
To 40% PAE and Beyond!

HIGH EFFICIENCY

Galactic Communications

CDMA PAMs

No Step Bias Needed



EiC, the InGaP HBT pioneer, is now blazing new paths in mobile handset PAM's. Our latest 4x4 mm devices achieve exceptional EFFICIENCY without bias switching.

		PAE	Pout	ACPR1	Icc@Pmax
ECM060	WCDMA	43 (%)	27 (dBm)	-42 (dBc)	335 (mA)
ECM064	US-PCS	40 (%)	28 (dBm)	-50 (dBc)	450 (mA)
ECM068	Korean PCS	40 (%)	28 (dBm)	-50 (dBc)	450 (mA)

EiC, A Name You Should Know

www.eiccorp.com Tel: 510 979 8953

MMIC VCOs Tune C-Band To 6.1 GHz

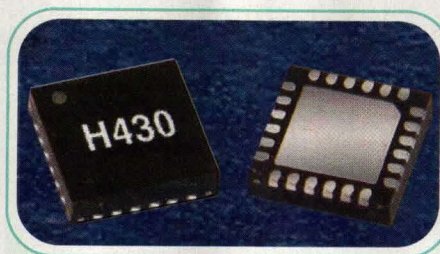
A PAIR OF GaAs InGaP heterojunction-bipolar-transistor (HBT) monolithic-microwave-integrated-circuit (MMIC) voltage-controlled oscillators (VCOs) are designed for C-band applications from 5.0 to 6.1 GHz. Well suited for IEEE 802.11a or HiperLAN 5-GHz wireless local-area networks (WLANs), very-small-aperture-satellite (VSAT) terminals, and UNII-band and point-to-point radios, these VCOs consume only 27 mA from a single +3-VDC supply. Model HMC430LP4 provides a +2 dBm buffered output and low phase noise of -103 dBc/Hz phase noise offset 100 kHz from carriers of 5.0 to 5.5 GHz. Model HMC431LP4 provides a +2 dBm buffered output and low phase noise of -102 dBc/Hz phase noise offset 100 kHz from carriers of 5.5 to 6.1 GHz.

Hittite Microwave Corp., 12 Elizabeth Dr., Chelmsford, MA 01842; (978) 250-3343, FAX: (978) 250-3373, Internet: www.hittite.com.

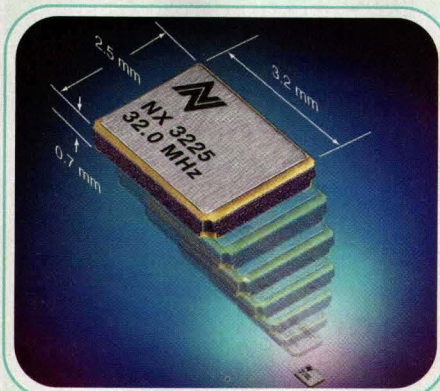
Miniature Crystals Resonate For Bluetooth

COMPACT DESIGNS REQUIRING miniature surface-mount crystals can now make use of the NX3225DA series which includes models operating at frequencies of 16, 20, 24, 26, and 32 MHz and are available at frequencies from 16 to 55 MHz. The crystals measure only 3.2 × 2.5 × 0.6 mm and weigh just 17 mg. The frequency tolerance is ±10 PPM at +25°C. The crystals, which are rated for operating temperatures from -10 to +60°C, require only 10 µW drive and have a standard load capacitance of 10 pF. The lead-free crystals are ideal for Bluetooth and other wireless applications. P&A: \$0.60 (10,000 qty); stock.

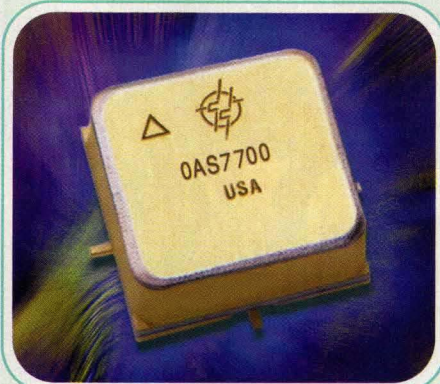
NDK America, Inc., 1701 E. Woodfield Rd., Suite 620, Schaumburg, IL 60173; (847) 517-2884, FAX: (847) 517-2887, e-mail: sales@ndkxtal.com, Internet: www.ndkxtal.com.



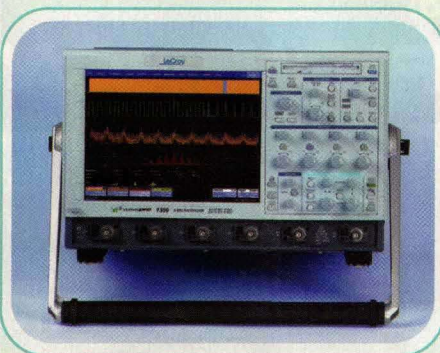
HITTITE MMIC VCO



NDK AMERICA
MINIATURE CRYSTALS



COUGAR VCO,
MODEL OAS7700



LECROY DSO

Tiny Oscillator Tunes 5.7 To 7.7 GHz

VOLTAGE-CONTROLLED-OSCILLATOR (VCO) model OAS7700 operates from 5700 to 7700 MHz. It combines an oscillator circuit, lowpass filter, and MMIC amplifier in a standard surface-mount package. Designed for low phase noise and linear tuning, the OAS7700 features phase noise of better than -100 dBc/Hz offset 100 kHz from the carrier, with average tuning sensitivity of 150 MHz/V and 2:1 tuning linearity over frequency and temperature. The VCO, which is rated for operating temperatures from -54 to +85°C, provides +10 dBm output power with ±2 dB output-power flatness across the full frequency range. Harmonics are suppressed by at least -25 dBc. The VCO is designed for tuning voltages from 0 to 15 V, and draws 100 mA from a +5-VDC supply.

Cougar Components, 290 Santa Ana Court, Sunnyvale, CA 94085; (408) 522-3838, FAX: (408) 522-3839, Internet: www.cougarcorp.com

SiGe Front Ends Streamline Scopes

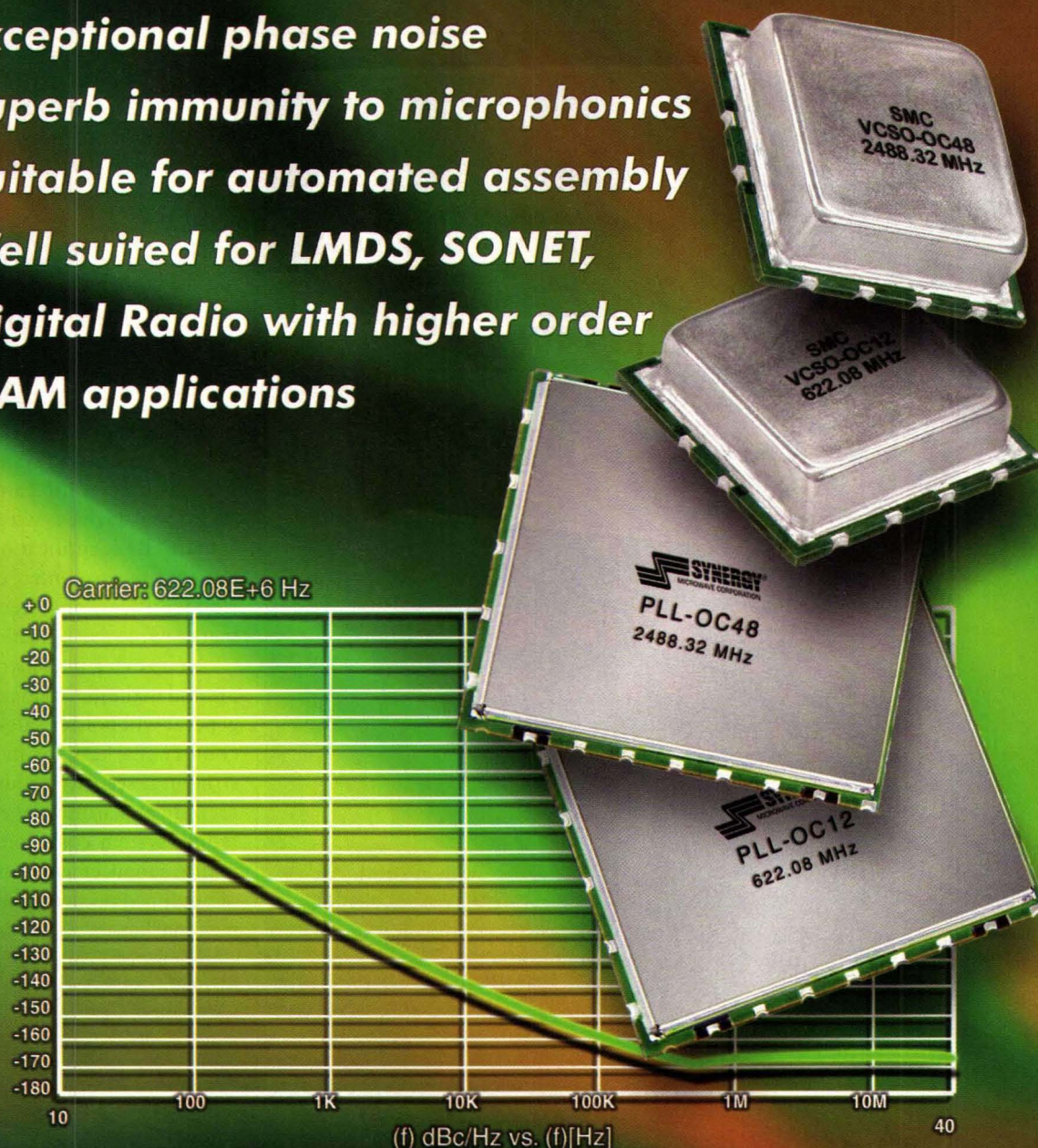
THE WAVEPRO 7300 and 7100 high-speed digital-storage oscilloscopes (DSOs) incorporate silicon-germanium-based front-end amplifiers and analog-to-digital converters (ADCs) to achieve jitter-free sampling of input signals at sampling rates to 20 GSamples/s. The WavePro 7300 offers a 3-GHz bandwidth while the 7100 has a 1-GHz bandwidth. The four-channel DSOs also provide single-shot sampling of 10 GSamples/s and a 2-ps-jitter noise floor. Signals are shown on a bright 10.4-in. (26.4-cm) SVGA display, and the company's proprietary fast-streaming X-Stream technology is used to overcome traditional trade-offs in processing the large amounts of data from long records.

LeCroy Corp., 700 Chestnut Ridge Rd., Chestnut Ridge, NY 10977; (845) 578-6020, FAX: (845) 578-5985, Internet: www.lecroy.com.

SAW

OSCILLATORS

- **Exceptional phase noise**
- **Superb immunity to microphonics**
- **Suitable for automated assembly**
- **Well suited for LMDS, SONET, Digital Radio with higher order QAM applications**



For additional information, contact Synergy's sales and application team.
201 McLean Boulevard, Paterson, NJ 07504
Phone: (973) 881-8800 Fax: (973) 881-8361 E-mail: sales@synergymwave.com
World Wide Web: www.synergymwave.com



Security Products Are In Demand

THE WORLD MARKET FOR security products and systems is forecast to expand almost nine percent annually through

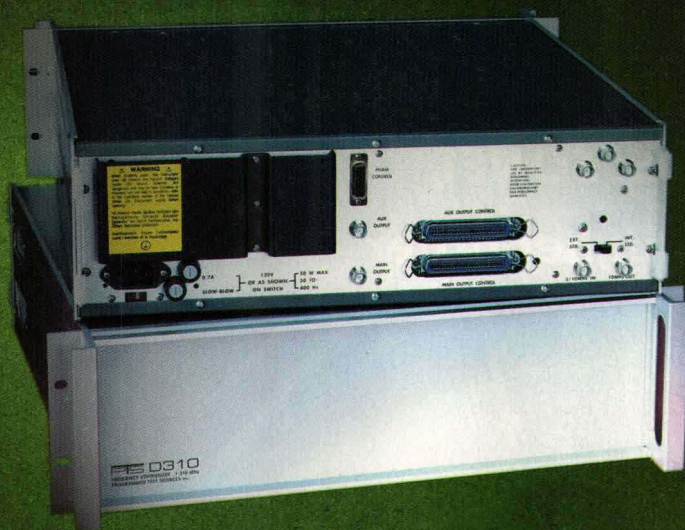
2006, reaching \$65 billion. Heightened fears of terrorism in the wake of the September 11, 2001 attacks on

the US, in tandem with rising conventional crime rates in many countries, will be the primary factor driving growth. Also important will be a robust pace of new product development, especially in the electronic security segment. These and other trends are presented in *World Security Products*, a study from The Freedonia Group, Inc., a Cleveland-based industrial market-research firm.

Higher-end electronic systems will log the best gains, based on less-penetrated markets, a high pace of new product development, falling prices, and the ability to thwart increasing threats ranging from retail shrinkage to terrorism. The most favorable prospects exist for higher-end systems and products such as color cameras, digital recording devices, wireless systems, "smart" RF identification (RFID) EAS tags and access-control cards, biometric identification systems, and automated explosive-detection devices.

An upswing in construction spending and in the global macroeconomy in general will bolster sales in developed country markets for mechanical and structural security products. Demand for burglar alarms will be predicated on falling system costs, ongoing performance enhancements, and penetration of untapped residential and small-business markets.

The fastest growth for security equipment is expected to be the world's developing regions—Asia, Latin America, Eastern Europe, Africa, and the Middle East. These areas feature largely unpenetrated private security markets and are characterized by rising crime rates, expanding economies, new business-formation activity heightened foreign investment, emerging middle and upper classes, and privatization of formerly state-owned industries such as banking and air travel. China will lead the pack, logging market growth in excess of 15 percent per annum through the end of the decade. **MRF**



PTS THE FASTER SOURCE NOW TO 6400 MHz

INDUSTRY'S LARGEST INSTALLED BASE

synthesized

LO sources

with:

- crystal control
- ultra-low phase noise
- μ s-switching
- multi-octave coverage
- fine resolution
- 0.1 MHz - 3.2 GHz

PTS HAS MANY DIFFERENT MODELS



PTS

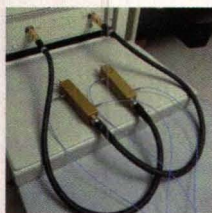
FREQUENCY SYNTHESIZERS

PROGRAMMED TEST SOURCES, INC.
9 Beaver Brook Road
Littleton, MA 01460

Tel: 978 486-3400
Fax: 978 486-4495
<http://www.programmedtest.com>
e-mail: sales@programmedtest.com



Innovative Solutions, Defining Technology



Gore's microwave test assemblies set the industry standard for high performance test and measurement applications through 67 GHz.

Interconnects

- *Dielectric Materials*
- *EMI Shielding Solutions*
- *Thermal Interface Materials*

W. L. Gore & Associates, Inc.

1 800 445-GORE
North America

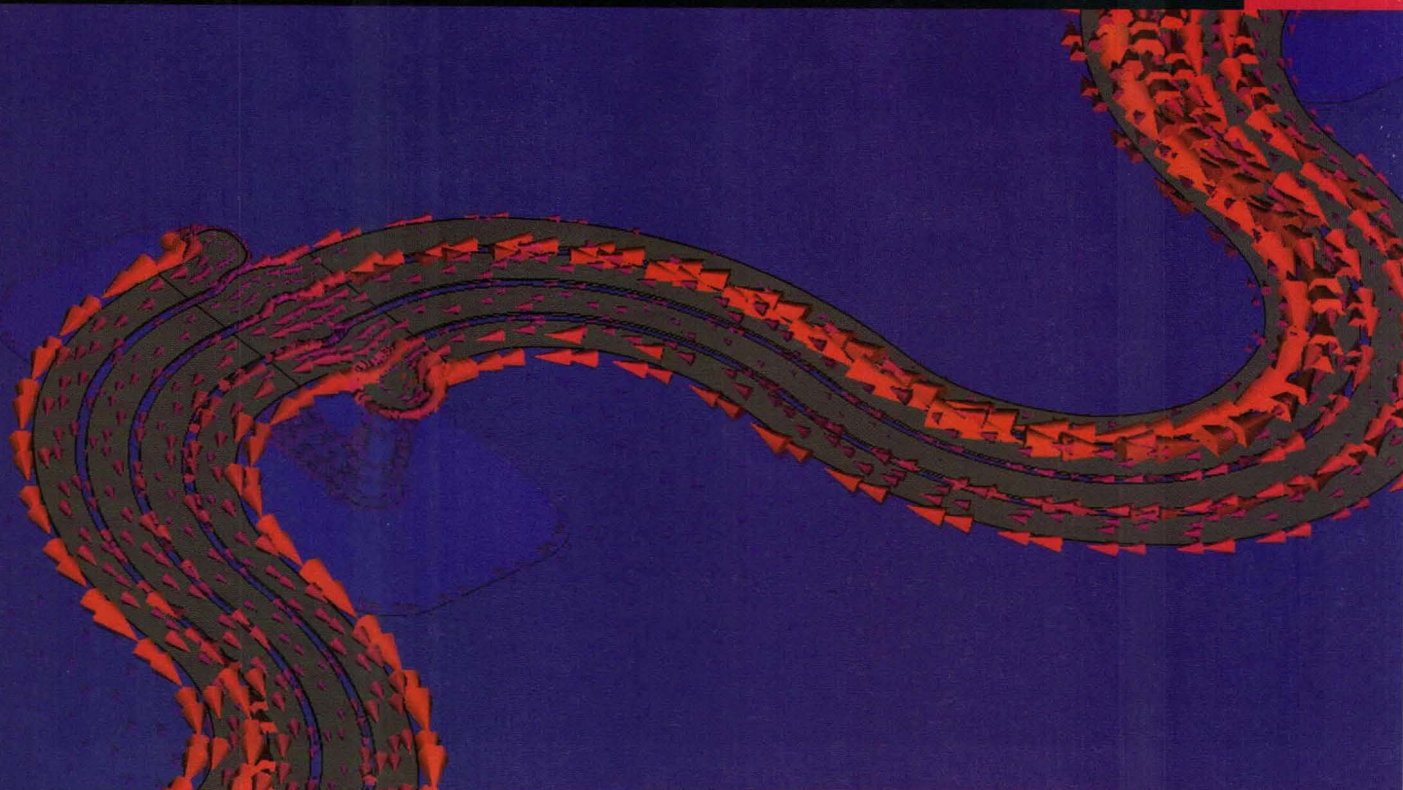
+ 1 (302) 292-5100
Internationally

www.goreelectronics.com/info/mw2



Life can be so straightforward.

3D EM
Simulation



3D EM
Simulation

→ ... it's just a question of knowing the best way to solve your problems. No matter how complicated things may look, with CST the process is simple and solutions are really straightforward.

CST MICROWAVE STUDIO® is quickly becoming the standard in the area of numerical field calculation, and is used world-wide by market leaders such as Motorola, Nokia, Philips, Raytheon, Siemens, and Sony. Typical applications include the simulation of waveguides, couplers, filters, power splitters, multi-plexers, planar structures, coax and multipin connectors, LTCCs, MMIC packages, RLC-extraction, and all kinds of antennas.

CST. CHANGING THE STANDARDS.
WWW.CST-WORLD.COM

CST of America®, Inc.

To request literature or a free demo CD, © 781-416-2782, or info@cst-america.com

CST
COMPUTER SIMULATION
TECHNOLOGY



CONTRACTS

Motorola's Global Telecom Solutions Sector (GTSS)—Has been awarded a \$43 million contract by Tata Teleservices for deployment of a code-division-multiple-access (CDMA) 1X network in the Indian cities of Maharashtra, Mumbai, and Goa. The CDMA 1X network is designed to provide customers with data services at speeds of up to 144 kb/s in addition to regular voice services. The deployment is scheduled to be completed by May 2003.

EMS Technologies, Inc.—Has announced an expanded contract valued at \$19.9 million to supply key defense-electronics hardware to Israel-based defense contractor Elisra Electronic Systems Ltd.

EMS' Space & Technology Group/Atlanta was awarded a \$10.9 million contract with Elisra in 1998 to build phased-array-transmitter (PAT) units. The units are instrumental to locating and communicating with guided rockets. Last fall, EMS began delivering qualified units, which have been successful in field tests. Under the new contract, which runs through 2005, EMS will supply additional PATs to establish a maintenance facility for the hardware in Israel.

Radiotronix, Inc. and Kustom Signals—Entered into a supplier agreement for a wireless, high-fidelity audio link and base station for law-enforcement use. The value of the agreement is said to be over \$1 million.

Poynting Antennas Ltd.—Has secured a multimillion-dollar Rand contract with Elson, an Athens-based company, to supply them with a complete range of broadband, high-power EW antennas. Elson is a subsidiary of SONAK S.A., which forms part of the AXON Holdings Group of companies.

The antennas will be used for transmitting high-power radio waves and monitoring the frequency spectrum over a wide band. The contract will run over a period of 20 months and includes the antenna designing and manufacturing that are specific to the clients' requirements.

FRESH STARTS

SoloMio Corp.—Announced that Telefónica Móviles España has selected the SoloMio Smart Call Services Platform as part of a framework agreement.

The agreement provides for other Telefónica Móviles operating companies to also use the Smart Call Platform. Telefónica Móviles España, the group's largest operator, is the first to have purchased the Smart Call Services Platform.

Andrew Corp. and Allen Telecom, Inc.—Signed a definitive agreement under which Andrew will acquire Allen in a stock-for-stock transaction valued at approximately \$500 million.

di/dt, Inc.—Has been acquired by Power-One, Inc. di/dt is

now a subsidiary of Power-One, and will continue its operations as "di/dt, a Power-One Company." Power-One is a designer and manufacturer of standard DC/DC converters, power supplies, and power-plant systems. Power-One was previously a stockholder and exclusive licensee of di/dt for key technology in the power industry.

Applied Wave Research, Inc.—Announced the relocation and expansion of the company's European headquarters in the United Kingdom. The new contact information for the UK office is: Applied Wave Research, Inc., 3rd Floor, Lyon Court, Walsworth Rd., Hitchin, Herts SG43 9SX, United Kingdom; 44 (0) 870 220 2334, FAX: 44 (0) 20 7504 3777. The new office will maintain responsibility for managing sales representatives and providing technical support throughout Europe.

QUALCOMM, Inc.—Announced that it will conduct the world's first GSM1x technology trial with China Unicom, the second-largest wireless-service provider in China. The trial will enable China Unicom's Global System for Mobile Communications (GSM) subscribers to access the high-speed data services of China Unicom's CDMA2000 1X wireless network and accelerate the commercial availability of GSM/CDMA dual-mode handsets.

China Unicom has an installed base of over eight million CDMA users and 60 million GSM users. The GSM1x trial will illustrate the technical feasibility of GSM1x technology as an option to allow China Unicom's existing GSM subscribers to take advantage of the benefits of enhanced CDMA2000 1X services, while preserving the existing GSM service layer and SIM-based subscription.

Anritsu Corp.—Purchased 500,000 shares of Nissho Electronics. With the purchase, worth an estimated \$4.7 million, Anritsu holds a 2-percent ownership stake in Nissho Electronics. As part of the transaction, the two companies agree to partner in the development of IP communications and network solutions.

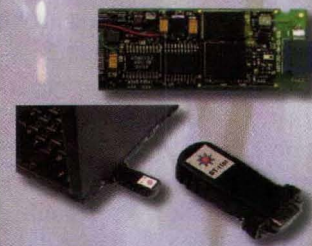
Anritsu and Nissho Electronics will leverage their relationship to develop IP measurement solutions for advanced IP applications, as well as Voice Over IP (VoIP) and network-security technology. The companies also plan to cross-sell IP products in Japan, co-develop IP network services, and co-expand the Chinese market.

Precision Plating Co.—Announced the formation of an Experimenting & Prototyping Lab (EPL) within its present production facility. The new EPL will allow Precision's customers to experiment with various plating finishes to discover the best appropriate materials and methods for the manufacturers' applications. Precision Plating will make the experimental products in-house for customers to performance-test the prototypes in real world applications.

Avnet Electronics Marketing's RF & Microwave Division—Has signed a North American distribution agreement with Skyworks Solutions, Inc., a wireless semiconductor company that is focused on RF and complete cellular system solutions for mobile-communications applications. **MRF**

**WIRELESS
RF MODULES**

Transmitters, Receivers,
Transceivers, High Speed,
Long Range, UHF Modems

**GPS RECEIVERS
and ANTENNAS****BLUETOOTH
MODULES**
RS-232

For more information, visit us at
www.lemosint.com
Call Toll Free
1-866-345-3667
Or Email **SALES@LE MOSINT.COM**



SAMYN

Samyn Named As GM For Littelfuse Electronics

Littelfuse, Inc. has appointed DAVID SAMYN as general manager of its electronics business. He was most recently vice president for global sales with Airfiber, Inc., an optical wireless telecom company in San Diego, CA.

LightPath Technologies, Inc.—TODD CHILDRESS to CFO; formerly vice president of finance. Also, EDWARD PATTON to vice president of marketing; formerly vice president of sales and marketing at Geltech, Inc.

Silicon Laboratories, Inc.—DAN ARTUSI to president and COO; formerly COO.

Etenna Corp.—SAM YOUNG to vice president of sales for the Western Americas and Asia-Pacific; formerly vice president of marketing for Hynix Semiconductor's Flash Business Unit. Also, JACK SHOYKHET to director of sales for the Eastern Americas and Europe; formerly vice president of sales operations and professional services with Telxon/Aironet Corp. In addition, ALEX VAUGHN to director of operations; formerly responsible for new product introduction and management of the customer-commitment process at Sanmina-SCI.

National Instruments—TIM DEHNE to senior vice president of R&D; formerly vice president of marketing and engineering. Also, ALEX DAVERN to CFO and senior vice president of manufacturing and IT operations; formerly CFO and vice president of IT. In addition, PETE ZOGAS to senior vice president of sales and marketing; formerly vice president of sales.

Optical Cable Corp.—CHARLES W. CARSON to senior vice president of marketing and strategy; formerly vice president of marketing and customer service for Pirelli Cables and Systems, North America.

Eagleware Corp.—MARK ZACHMANN to vice president of research and development; formerly founder and CEO of ZSoft Corp. Also, GARY KARSTEDT to vice

president of sales; formerly operations manager at Agilent's Contact Center.
Broadband Services, Inc.—COREY WALKER to director of MapVantage GIS Operations; formerly vice president and general manager of engineering for AM Broadband Services, Inc.

SnapTrack, Inc.—DR. KAMIL A. GRAJSKI to senior vice president and general manager; formerly vice president of engineering.

Rockwell Collins—KENT L. STATLER to senior vice president of operations; formerly vice president of manufacturing operations.

Semflex—RON DESILETS to Western regional sales manager; formerly Mil/Aero business development specialist at Trompeter Electronics.

Calmont Wire & Cable, Inc.—LINDA CUNNINGHAM to sales engineer for the Southern California territory; formerly employed in the medical and computer industries.



CUNNINGHAM

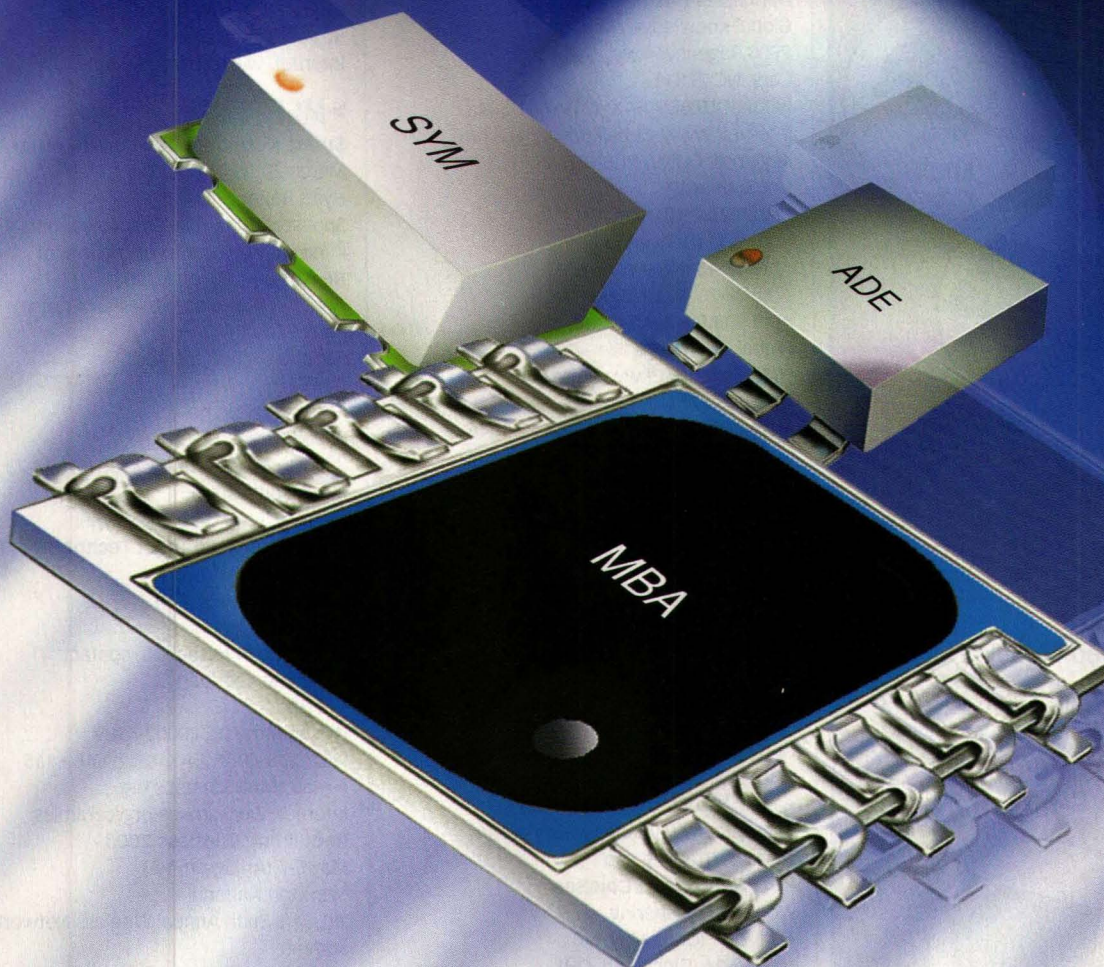


WANG

Olympus Partnership Development Group (PDG)—PETER WANG to optical product marketing manager; formerly senior product manager for Alliance Fiber Optic Products.

Columbitech—ASA HOLMSTROM to the position of president; formerly CEO at Kvadrat Teknik AB. **MRF**

WIDEBAND HIGH IP3 MIXERS



+4 to +17dBm LO from **\$6⁹⁵**
(ea. Qty. 10)

Now you can obtain *spectacular wideband IP3 performance* at a value price with Mini-Circuits team of MBA, ADE, and SYM mixers. Optimized to deliver the highest IP3 for a given LO drive, these affordable surface mount mixers range from 32dBm IP3 for +17dBm LO power...to 15dBm IP3 for LO down to +4dBm. In terms of E Factor (IP3 Figure Of Merit), these mixers go as high as 1.5 providing superior intermodulation suppression from 5 to 5900MHz while at the same time achieving low conversion loss and high isolation. You'll also be pleased to know the Blue Cell™ MBA model covers your higher frequency designs with superb temperature stability, high repeatability, and ultra-thin 0.070" profile. Now, high IP3, higher performance, and value pricing have merged. The result is Mini-Circuits wideband high IP3 mixers...the *clear choice!*



Mini-Circuits...we're redefining what VALUE is all about!

Typical Specifications:						Conv. Loss Midband (dB)	Price Ea. Qty. 10
Model	Freq. (MHz)	LO Level (dBm)	IP3 Midband (dBm)	E Factor*			
ADE-10MH	800-1000	+13	26	1.3	7.0	6.95	
ADE-12H	500-1200	+17	28	1.1	6.7	8.95	
•MBA-591L	4950-5900	+4	15	1.1	7.0	6.95	
SYM-25DLHW	40-2500	+10	22	1.2	6.3	7.95	
SYM-25DMHW	40-2500	+13	26	1.3	6.6	8.95	
SYM-24DH	1400-2400	+17	29	1.2	7.0	9.95	
SYM-25DHW	80-2500	+17	30	1.3	6.4	9.95	
SYM-22H	1500-2200	+17	30	1.3	5.6	9.95	
SYM-20DH	1700-2000	+17	32	1.5	6.7	9.95	
SYM-18H	5-1800	+17	30	1.3	5.75	9.95	
SYM-14H	100-1370	+17	30	1.3	6.5	9.95	
SYM-10DH	800-1000	+17	31	1.4	7.6	9.95	

*E Factor = [IP3 (dBm) - LO Power (dBm)] ÷ 10. See web site for E Factor application note.
ADE models protected by U.S. patent 6,133,525.

•MBA Blue Cell™ model protected by U.S. patents 5,534,830 5,640,352 5,640,699.



Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

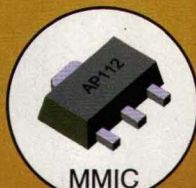
ISO 9001 CERTIFIED

F 345 Rev A

LNA / Gain Block Converter Power Amp Sub-Modules LMDS & MMDS



LNA



MMIC

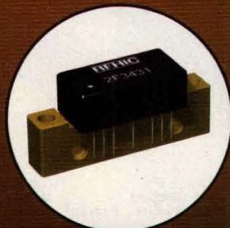


Converter



Sub-Modules

CATV Line Amp



RFHIC

Look for us at the
Cable-Tec Expo 2003
(Philadelphia, May 12-14)
Booth #2216

2003 MTT-Show
(Philadelphia, June 10-12)
Booth #2055

Tel: 82-31-420-5511
Fax: 82-31-420-5588
www.rfhic.com
rfsales@rfhic.com

► SHORT COURSES

Converging Voice and Data Networks

March 24-25 (Dallas, TX)
April 7-8 (Denver, CO)
April 14-15 (New York, NY)
April 21-22 (Washington, DC)
April 28-29 (Anaheim, CA)
Global Knowledge
9000 Regency Pkwy., Suite 500
Cary, NC 27511
(800) COURSES, FAX: (919) 461-8646
Internet: www.globalknowledge.com
Keyword: CONVERGENCE

Voice over IP

March 26-28 (Dallas, TX)
April 9-11 (Denver, CO)
April 16-18 (New York, NY)
April 23-25 (Washington, DC)
April 30-May 2 (Anaheim, CA)
Global Knowledge
9000 Regency Pkwy., Suite 500
Cary, NC 27511
(800) COURSES, FAX: (919) 461-8646
Internet: www.globalknowledge.com
Keyword: VOIP

Indoor Networks: Principles & Practice of In-Building Wireless Engineering

March 27-28 (Chicago, IL)
April 17-18 (Newark, NJ)
May 7-8 (Washington, DC)
June 23-24 (Boston, MA)
August 7-8 (Miami, FL)
September 11-12 (San Francisco, CA)
For further information contact:
Dr. Eric Reifsnider
(540) 818-2281

e-mail: training@wirelessvalley.com
Internet: www.wirelessvalley.com/Services/Training.asp

R.A. Wood Short Courses

Wireless Engineering

April 7-11 (Cape May, NJ)
May 12-16 (Cincinnati, OH)
Introductory RF and Microwaves
March 20-21 (Arlington, VA)
May 1-2 (Cincinnati, OH)

RF and Microwave Receiver Design

March 24-26 (Arlington, VA)
May 5-7 (Cincinnati, OH)

RF Power Amps, Classes A-S: How the Circuits Operate, How to Design Them, & When to Use Each

April 29-30 (Cape May, NJ)
May 8-9 (Cincinnati, OH)
R.A. Wood Associates
1001 Broad St., Suite 450
Utica, NY 13501
(315) 735-4217, FAX: (315) 735-4328

e-mail: rawood@rawood.com

Internet: www.rawood.com

Antennas: Principles, Design, and Measurements

April 29-May 2 (Dulles, VA)
Northeast Consortium for Engineering Education (NCEE)

education

Attention: Leanne Traver
68 Port Royal Square
Port Royal, VA 22535-0068
(804) 742-5611, FAX: (804) 742-5030
e-mail: ed-pub@crosslink.net
Internet: www.antennacourse.com

Oxford Design Week

June 29-July 4 (Oxford, England)
St. Anne's College
Internet: www.rttonline.com

► MEETINGS

Smart Networks Developer Forum

March 23-26 (Dallas, TX)
Hyatt Regency Dallas
Sponsors: Motorola, Smart Networks Alliance
Internet: www.motorola.com/sndf

RF & Hyper Europe 2003

April 1-3 (Porte de Versailles, France)
Paris Expo

For information, contact:

BIRP

11, rue du Perche

75003 Paris, France

33 (0)1 44 78 99 30, FAX: 33 (0)1 44 78 99 49

e-mail: crey@birp.rf

Internet: www.birp.com/hyper

Ceramic Interconnect Technology: The Next Generation

April 7-9 (Denver, CO)

The Westin Hotel

For further information, contact:

IMAPS Registration

611 2nd St., NE

Washington, DC 20002-4909

(202) 548-4001, FAX: (202) 548-6115

e-mail: IMAPS@imaps.org

Internet: www.imaps.org/ceramics

In-Building Wireless 2003

May 5-7 (Arlington, VA)

Sheraton National

IIRUSA's Sixth Annual Wireless Networking Summit

To exhibit, sponsor, or attend, call (800) 670-8200

e-mail: info@iir-inbuilding.com

Internet: www.iirusa.com/inbuildingwireless/

► CALL FOR PAPERS

2003 IEEE GaAs IC Symposium

November 9-12 (San Diego, CA)

Deadline for the electronic receipt of

Abstracts is May 5

E-mail a one-page Abstract with up to two pages of supporting material to:

2003abstracts@sirenta.com

Submissions must be in .doc or .pdf format only

Further questions on Abstract submission can be addressed to:

Brad Nelson, Symposium Technical Program Chair

(408) 616-5400

e-mail: bnelson@sirenta.com

Internet: www.gaasic.org/

2W & 5W DC to 18GHz ATTENUATORS

IN STOCK



\$29⁹⁵
from ea. (1-49)

Rugged Stainless Steel Construction, High Repeatability, Miniature Size, Low Cost, and Off-The-Shelf Availability are some of the features that make Mini-Circuits "BW" family of precision fixed attenuators stand above the crowd! This extremely broad band DC to 18GHz series is available in 5 watt Type-N and 2&5 watt SMA coaxial designs, each containing 15 models with nominal attenuation values from 1 to 40dB. Built tough to handle 125 watts maximum peak power, these high performance attenuators exhibit excellent temperature stability, 1.15:1 VSWR typical, and cover a wealth of applications. So contact Mini-Circuits today, and capture this next generation of performance and value!

Mini-Circuits...we're redefining what VALUE is all about!

MODELS (Add Prefix BW-)

2W SMA	5W SMA	5W Type-N	Attenuation (dB)	
\$29.95	\$44.95	\$54.95	Nominal	Accuracy*
S1W2	S1W5	N1W5	1	±0.40
S2W2	S2W5	N2W5	2	±0.40
S3W2	S3W5	N3W5	3	±0.40
S4W2	S4W5	N4W5	4	±0.40
S5W2	S5W5	N5W5	5	±0.40
S6W2	S6W5	N6W5	6	±0.40
S7W2	S7W5	N7W5	7	±0.60
S8W2	S8W5	N8W5	8	±0.60
S9W2	S9W5	N9W5	9	±0.60
S10W2	S10W5	N10W5	10	±0.60
S12W2	S12W5	N12W5	12	±0.60
S15W2	S15W5	N15W5	15	±0.60
S20W2	S20W5	N20W5	20	±0.60
S30W2	S30W5	N30W5	30	±0.85
S40W2	S40W5	N40W5	40	±0.85

*At 25°C includes power and frequency variations up to 12.4GHz. Above 12.4GHz add 0.5dB typ. to accuracy.

DC-18GHz Adapters NOW AVAILABLE!

Type-N to SMA \$22⁹⁵ ea. (1-49) SMA-M to SMA-M \$8⁹⁵ ea. (1-49)



For detailed adapter specs visit: www.minicircuits.com/adapter.html

Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE

YEW™ The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

ISO 9001 CERTIFIED

F 331 Rev B

CDMA-Based Data Transmitter Supports Embedded Sensing

MACHINE HEALTH MONITORING is a task well suited for an embedded wireless data transmitter. Unfortunately, because of the sometimes-harsh electrical environments posed by automated machine systems, a transmitter can face severe interference along the way of reporting on machine system health. For that reason, Robert Gao and Philipp Hunerberg of the Department of Mechanical and Industrial Engineering of the University of Massachusetts (Amherst, MA) explored the design of a wireless data transmitter based on code-division-multiple-access (CDMA)

technology for embedded sensing applications. Backed by MATLAB computer simulations at 2.4 GHz, the researchers developed a prototype system aimed at monitoring the condition of machine bearings, but also suitable for data loggers and handheld measuring equipment. The system consisted on an RF interface, DSP chip, sensor input port, and memory interface. See "Design of A CDMA-Based Wireless Data Transmitter for Embedded Sensing," *IEEE Transactions on Instrumentation and Measurement*, December 2002, Vol. 51, No. 6, p. 1259.

Printed-Array Antenna Offers Almost 120-Percent Bandwidth

AN ULTRABROADBAND ANTENNA was designed nominally to bridge several communications standards, such as 3G cellular, Bluetooth, and WLANs, with a single device. A design developed by Kamran Ghorbani of RMI University (Melbourne, Australia) and Rod B. Waterhouse of Dorsal Networks (Columbia, MD)

consists of a diplexer and two aperture stacked patch antennas. It achieves gain from 0.7 to almost 4 GHz with 10-dB bandwidth of almost 120 percent. See "Ultrabroadband Printed (UBP) Antenna," *IEEE Transactions on Antennas and Propagation*, December 2002, Vol. 50, No. 12, p. 1697.

Broadband Analog Phase Shifter Controls 360-deg. Range At L-Band

ANALOG PHASE SHIFTERS AT L-BAND do not commonly provide a phase-control range as broad as 360 deg. But that is what several researchers from Hong Kong recently achieved for a device capable of operating from 1 to 2 GHz. K. Liu, E.Y B. Pun, and X.J. Tian of the Department of Electrical Engineering of the City University of Hong Kong (Kowloon, Hong Kong) described a monolithic design based on varactor diodes with a total phase shift of 360 deg. from 1.2 to 2.0 GHz. With less than 2-dB insertion loss across the operating band, the phase shifter also achieved linear deviation of less ± 2.5 percent.

The reflection-type phase shifter consists of two varactor diodes connected in parallel with quarter-wavelength transmission lines joining the diodes. The phase shift is produced by vary-

ing the capacitance of the varactor diodes according to the applied bias voltage. In essence, careful selection of the varactor diodes, along with computer-aided-engineering (CAE) circuit optimization, was critical to achieving the three sometimes conflicting goals of 360-deg. phase shift, broad bandwidth, and linear phase shift. Using a three-port circulator to connect the phase shifter to test equipment, measurements on the component revealed performance values that were very close to computer-simulated values. By studying this design, the researchers developed new bandwidth design equations to support improved phase-shifter designs.

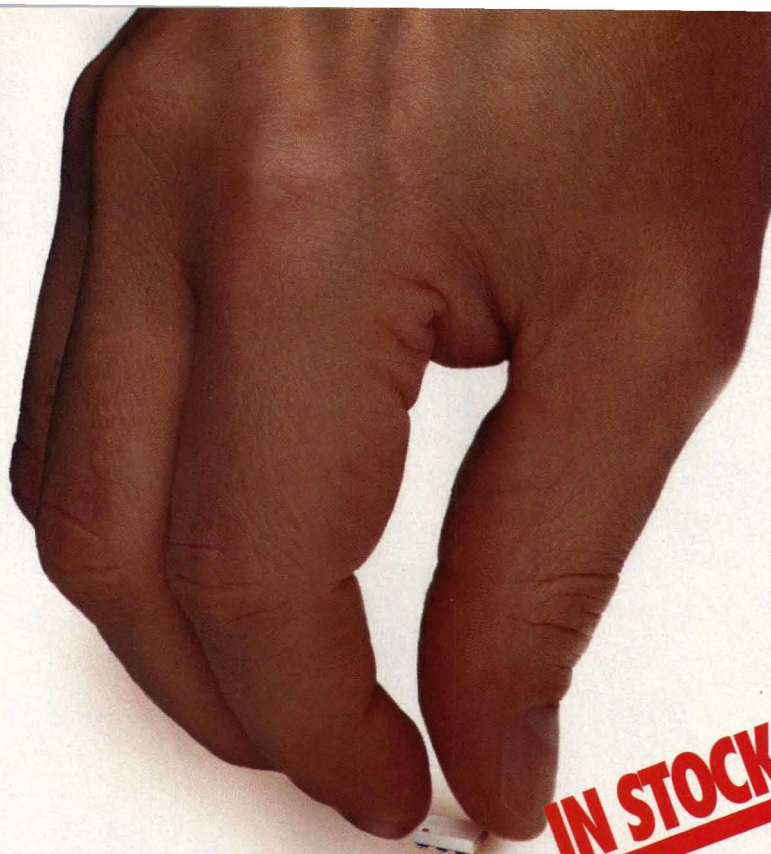
See "L-Band 360° Broad-bandwidth Monolithic Analog Phase Shifter," *Microwave and Optical Technology Letters*, February 5, 2003, Vol. 36, No. 3, p. 164.

Studying DTV Antenna And Receiver Mismatch Effects

ANTENNA AND RECEIVER MISMATCH effects have been studied extensively in military systems, but similar research has also been conducted recently in digital-television (DTV) broadcast systems. Work performed by Denise Schnelle and R. Evans Wetmore of the News Technology Group of Fox Entertainment Group (Los Angeles, CA) investigated the effects of different receiving antennas on DTV reception.

Laboratory measurements revealed that DTV receivers can operate with signal levels as low as -80 dBm, although the effects of mis-

match can render a receiver ineffective even with higher signal levels. The researchers tested 12 commercial antennas and discovered that those with the lowest return losses and mismatch losses delivered the best DTV performance, although not all of the antennas provided adequate performance levels under all conditions. See "Evaluation of Antenna and Receiver Mismatch Effects on DTV Reception," Cross-Correlation Noise Measurement in A/D Converters," *IEEE Transactions on Broadcasting*, December 2002, Vol. 48, No. 4, p. 365.



IN STOCK

INNOVATIVE MIXERS

WOW!

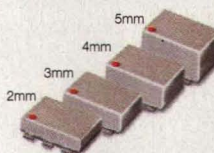
\$1.99

from (ea. Qty. 100)

.smaller size .better performance .lower cost

it
innovative
technology

Searching high and low for a better frequency mixer? Then take a closer look at the Innovative Technology built into Mini-Circuits ADE mixers. **Smaller size** is achieved using an ultra-slim, patented package with a profile as low as 0.082 inches (2mm) in height. Electrically, ADE mixers deliver **better performance** than previous generation mixers through all welded connections with unique assembly construction which reduces parasitic inductance. The result is dramatically improved high frequency and IP2-IP3 performance. Plus, ADE's innovative package design allows water wash to drain and eliminates the possibility of residue entrapment. Another ADE high point is the **lower cost**...priced from only \$1.99 each. So, if you've been searching high and low for a mixer to exceed expectations...ADE is **it**™



ACTUAL SIZE

ADE Mixers...Innovations Without Traditional Limitations!

ADE* TYPICAL SPECIFICATIONS:

MODEL	LO Power (dBm)	Freq. (MHz)	Conv. Loss Midband (dB)	L-R Isol. Midband (dB)	IP3 @ Midband (dBm)	Height (mm)	Price (Sea. Qty. 10-49)
ADE-1L	+3	2-500	5.2	55	16	3	3.95
ADE-3L	+3	0.2-400	5.3	47	10	4	4.25
ADEX-10L	+4	10-1000	7.2	60	16	3	2.95
ADE-1	+7	0.5-500	5.0	55	15	4	1.99▲
ADE-1ASK	+7	2-600	5.3	50	16	3	3.95
ADE-2	+7	5-1000	6.67	47	20	3	1.99▲
ADE-2ASK	+7	1-1000	5.4	45	12	3	4.25
ADE-6	+7	0.05-250	4.6	40	10	5	4.95
ADEX-10	+7	10-1000	6.8	60	16	3	2.95
ADE-12	+7	50-1000	7.0	35	17	2	2.95
ADE-4	+7	200-1000	6.8	53	15	3	4.25
ADE-14	+7	800-1000	7.4	32	17	2	3.25
ADE-901	+7	800-1000	5.9	32	13	3	2.95
ADE-5	+7	5-1500	6.6	40	15	3	3.45
ADE-5X	+7	5-1500	6.2	33	8	3	2.95
ADE-13	+7	50-1600	8.1	40	11	2	3.10
ADE-11X	+7	10-2000	7.1	36	9	3	1.99▲
ADE-20	+7	1500-2000	5.4	31	14	3	4.95
ADE-18	+7	1700-2500	4.9	27	10	3	3.45
ADE-3GL	+7	2100-2800	6.0	34	17	2	4.95
ADE-3G	+7	2300-2700	5.6	36	13	3	3.45
ADE-28	+7	1500-2800	5.1	30	8	3	5.95
ADE-30	+7	200-3000	4.5	35	14	3	6.95
ADE-32	+7	2500-3200	5.4	29	15	3	6.95
ADE-35	+7	1600-3500	6.3	25	11	3	4.95
ADE-18W	+7	1750-3500	5.4	33	11	3	3.95
ADE-30W	+7	300-4000	6.8	35	12	3	8.95
ADE-1LH	+10	0.5-500	5.0	55	15	4	2.99
ADE-1LHW	+10	2-750	5.3	52	15	3	4.95
ADE-1MH	+13	2-500	5.2	50	17	3	5.95
ADE-1MHW	+13	0.5-600	5.2	53	17	4	6.45
ADE-10MH	+13	800-1000	7.0	34	26	4	6.95
ADE-12MH	+13	10-12000	6.3	45	22	3	6.45
ADE-25MH	+13	5-2500	6.9	34	18	3	6.95
ADE-35MH	+13	5-3500	6.9	33	18	3	9.95
ADE-42MH	+13	5-4200	7.5	29	17	3	14.95
ADE-1H	+17	0.5-500	5.3	52	23	4	4.95
ADE-1HW	+17	5-750	6.0	48	26	3	6.45
ADEX-10H	+17	10-1000	7.0	55	22	3	3.45
ADE-10H	+17	400-1000	7.0	39	30	3	7.95
ADE-12H	+17	500-1200	6.7	34	28	3	8.95
ADE-17H	+17	100-1700	7.2	36	25	3	8.95
ADE-20H	+17	1500-2000	5.2	29	24	3	8.95

Component mounting area on customer PC board is 0.320"x 0.290".

*Protected by U.S. patent 6133525. ▲100 piece price.

Mini-Circuits®

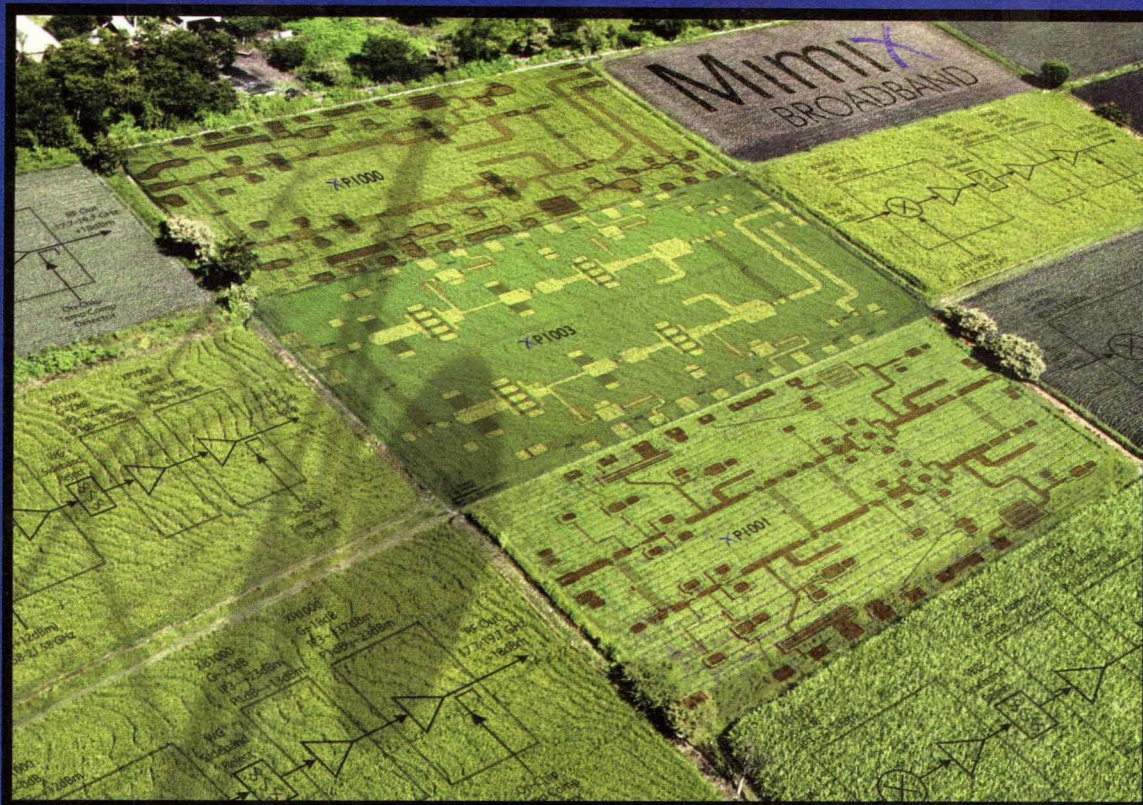
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

ISO 9001 ISO 14001 CERTIFIED

267 Rev O



MIMIX BROADBAND IS OUTSTANDING IN THE HIGH POWER AMPLIFIER FIELD

Whether your application calls for a linear power amplifier with high OIP3 for superior operation in high index digital radio modulation schemes, or greater than one watt saturated power for high performance millimeter-wave constant envelope satellite or terrestrial radar applications...

Look to Mimix Broadband for a powerful solution.

Many of our power amplifiers also offer on-chip temperature compensated power detectors to eliminate the need for discrete detector circuits. And Mimix Broadband provides extensive testing on all amplifiers and even guarantees IP3, P1dB or Psat performance. We cover customer needs with excellent performance and diverse applications solutions.

Mimix Broadband's power amplifiers. Outstanding in our field.

Comparing High-Frequency Control Devices

Three different semiconductor processes, based on the use of GaAs, InP, and GaN HEMT devices, were compared for their suitability as microwave switches.

Solid-state switches can be fabricated with a variety of different semiconductor technologies, usually selected on the basis of performance requirements. For this study, single-pole, single-throw (SPST) switches were evaluated based on three different high-electron-mobility-transistor (HEMT) devices: InP, GaAs, and GaN. Although the least-mature process, the GaN HEMT switches exhibited high breakdown

ital communications systems. The choice of semiconductor material for these devices is generally dictated by the

MOHAMED KAMECHE AND MOHAMMED BEKHTI

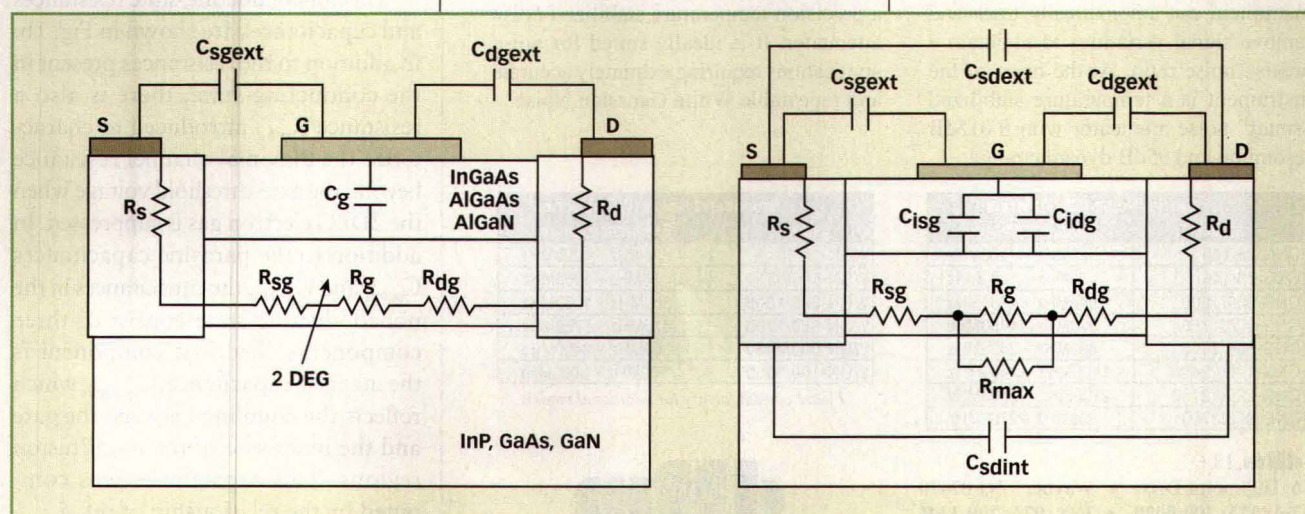
Members of the Technical Staff

National Centre of Space Techniques,
Algeria, BP 13, 1 Avenue de la Palestine,
31200 - Arzew - Algeria; (00) 213 41 47 22 17
FAX: (00) 213 41 47 34 54.

voltages compared to the other two processes, with better power handling (to +15 dBm without degradation in RF isolation and insertion loss).

Such solid-state switches have been used successfully as control devices for transmitter (Tx) and receiver (Rx) switching functions in a variety of dig-

ital communications systems. The choice of semiconductor material for these devices is generally dictated by the material's critical breakdown field, its saturation drift velocity, and its thermal conductivity. GaAs- and InP-based HEMT switches offer high isolation, low insertion loss, and high switching speed¹ but are limited in power-handling capabilities due to modest critical breakdown fields. On the other hand, due to



1. These diagrams show the origins of the resistances and capacitances for two states of a HEMT control device: (a) in the conducting or "on" state and (b) in the nonconducting or "off" state.

its wide bandgap structure, AlGaIn/GaN HEMTs are ideal for realizing microwave control and amplification functions.²

GaN is a wide bandgap semiconductor material, with a high critical breakdown field, high saturation drift velocity, and good thermal conductiv-

ity compared to GaAs and InP (Table 1). It offers more than twice the bandgap energy of InP and GaAs materials,

Table 1: Comparing GaAs, InP, and GaN properties at 300 K.

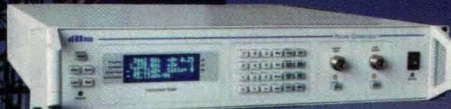
	GaAs	InP	GaN
BANDGAP ENERGY (eV)	1.43	1.34	3.4
SATURATION VELOCITY (m/s)	10 ₅	0.9 x 10 ₅	2.7 x 10 ₅
CRITICAL BREAKDOWN FIELD (MV/m)	40	50	330
RELATIVE DIELECTRIC CONSTANT	12.8	12.5	8.9
THERMAL CONDUCTIVITY (W/mK)	50	69	170

Need *precise* Noise?



CNG series

- ◆ Standard models available to 3GHz
- ◆ Custom solutions to 30GHz
- ◆ Noise attenuator resolution 0.015dB
- ◆ Extremely fast execution time
- ◆ Reliable solid state design



WGN series

Give us a call to discuss your Noise Generator needs...

CNG Series

The CNG series allows carrier to noise (C/N) or carrier to interference (C/I) ratios to be easily programmed in a user specified occupied signal bandwidth. The instrument can automatically track and remove signal variations to maintain a precise noise ratio. At the heart of the instrument is a temperature stabilized "smart" noise attenuator with 0.015dB resolution and 95dB dynamic range.

Carrier/Noise (CNG) Series	
Model	Frequency range
CNG-26/180	26MHz - 180MHz
CNG-70/140	50MHz - 180MHz
CNG-800/1000	800MHz - 1000MHz
CNG-870/1750	870MHz - 1750MHz
CNG-800/2400	800MHz - 2400MHz
CNG-1700/2400	1700MHz - 2400MHz
CNG-2200/2700	2200MHz - 2700MHz
CNG-800/2700	800MHz - 2700MHz

WGN Series

The WGN series is a cost effective, highly accurate Additive White Gaussian Noise generator with a oven stabilized noise source (with high crest factor) and a precision temperature stabilized noise attenuator. It is ideally suited for noise applications requiring extremely accurate and repeatable White Gaussian Noise.

Broadband Noise (WGN) Series	
Model	Frequency range
WGN-1/200	1MHz - 200MHz
WGN-5/1005	5MHz - 1005MHz
WGN-800/1000	800MHz - 1000MHz
WGN-870/1750	870MHz - 1750MHz
WGN-800/2400	800MHz - 2400MHz
WGN-100/3000	100MHz - 3000MHz

Please consult factory for additional models

dBm, LLC

6 Highpoint Drive ♦ Wayne, NJ 07470
Tel (973) 709-0020 ♦ Fax (973) 709-1346

www.dbmcorp.com



RF Test Equipment for Wireless Communications

with more than three times the thermal conductivity of GaAs (implying better power-handling capability).

To evaluate the three semiconductor materials, a HEMT device structure was selected as optimum for high-frequency switching and control functions. The resistances and capacitances forming the HEMT equivalent circuit can be subdivided into configurations representing the two switch states (on and off). For most control applications, at frequencies of most interest, the on-state impedance is mostly resistive while the off-state impedance is mostly capacitive. **Figure 1(a)** shows the physical origin of the various important resistances and capacitances in the conducting state. The resistances present in this state are the channel resistance, R_{ch} , and the parasitic source resistance, R_s , and parasitic drain resistance, R_d . The capacitances present in the on-state configuration are the gate capacitance, C_g , the extrinsic drain-gate capacitance, C_{dgext} , and the extrinsic source-gate capacitance, C_{sgext} . These resistances and capacitances are estimated using the same techniques used in refs. 3 and 4.

The nonconducting-state resistances and capacitances are shown in Fig. 1b. In addition to the resistances present in the conducting-state, there is also a resistance R_{max} introduced to characterize the maximal channel resistance beyond the gate-threshold voltage when the 2DEG electron gas is suppressed. In addition to the parasitic capacitances C_{sgext} and C_{dgext} , the capacitances in the nonconducting state consist of three components. The first component is the intrinsic capacitance, $C_{igs(gd)}$ which reflects the coupling between the gate and the inner side of the n+ diffusion regions. This capacitance was computed by the relationship of ref. 5.

The second component is the intrinsic



300MHz-6GHz LTCC MIXERS

\$395 **IN STOCK**
from ea. (Qty. 1000)

For Commercial, Military, and Industrial Use, Mini-Circuits proudly introduces MCA1, the world's first commercially available line of *low temperature cofired ceramic (LTCC)* frequency mixers! Highly reliable, extremely broad band, and very low in cost, these patent pending double balanced mixers have excellent electrical performance and are available in level 7, 10, and 13 (LO) models for your 300MHz to 6GHz designs. As for ruggedness and reliability, MCA1 mixers have all circuitry hermetically embedded inside the ceramic making them impervious to most environmental conditions. The process also gives you superior stability under temperature, high repeatability, and compact 0.065" profile. They're ideal for the COTS program, as well as your commercial and industrial applications. So contact Mini-Circuits now. Our team is ready to handle your needs worldwide with quick shipments, custom designs, high volume production capability, and fast turn-around.

Mini-Circuits...we're redefining what VALUE is all about!



Typical Specifications

Actual Size	Model	LO Level (dBm)	Freq. (MHz)	Conv. Loss (dB)	LO-RF Isol. (dB)	Price \$ ea. (Qty. 10)
	MCA1-24	7	300-2400	6.1	40	5.95
	MCA1-42	7	1000-4200	6.1	35	6.95
	MCA1-60	7	1600-6000	6.2	30	7.95
	MCA1-24LH	10	300-2400	6.5	40	6.45
	MCA1-42LH	10	1000-4200	6.0	38	7.45
	MCA1-60LH	10	1700-6000	6.3	30	8.45
	MCA1-24MH	13	300-2400	6.1	40	6.95
	MCA1-42MH	13	1000-4200	6.2	35	7.95
	MCA1-60MH	13	1600-6000	6.4	27	8.95

BLUE CELL™

Detailed Performance Data & Specs Online at: www.minicircuits.com/mixer2.html

Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

ISO 9001 ISO 14001 CERTIFIED

385 Rev B

insic capacitance C_{sdint} that couples through the GaAs substrate. The third component is the extrinsic capacitance C_{sdext} that couples through the air, namely the metallic source-to-drain coupling capacitance. Determining the values of these last two elements is

based on the relationships of ref. 3. The model used in this article includes an additional capacitance corresponding to the InGaAs, AlGaAs, or AlGaN neutralization.

Finally, the modeled capacitances and resistances can be combined to

Table 2: Comparing cutoff frequencies and breakdown voltages for the switch technologies.

TECHNOLOGY	BROADBAND CUTOFF FREQUENCY (GHz)	BREAKDOWN VOLTAGE (V)
InGaAs/InP HEMT	565	5.5
AlGaAs/GaAs HEMT	400	9.5
AlGaN/GaN HEMT	285	80

form an equivalent circuit that represents the two states of the HEMT control device. It is well known that the on-state resistance, R_{ON} , and the off-state capacitance, C_{OFF} , are the key equivalent-circuit elements used in characterizing broadband HEMT switches. The broadband cutoff frequency figure of merit, f_c , can be defined as:

$$f_c = \frac{1}{(2\pi R_{ON} C_{OFF})} \quad (1)$$

Because R_{SD} and C_{SD} are key equivalent-circuit parameters affecting HEMT device and switch performance over gate voltage and input power, this analysis will focus on these two parameters.

Figures 2 and 3 show computed characteristics of the normalized source-drain resistance and capacitance at a frequency of 1 GHz for three different technologies. A significant dependence of the extracted total source-drain resistance on V_g can be observed. When the gate voltage decreases toward the threshold voltage (-0.1 V for InGaAs/InP, -0.46 V for AlGaAs/GaAs, and -1.04 V for AlGaN/GaN), R_{SD} increases rapidly. This is in good agreement with the results obtained by Caverly⁵ on modeling the AlGaN/GaN HEMT. In the gate-voltage range greater than the threshold voltage, R_{SD} is rather flat, which is a good evaluation of the on-state resistance, R_{ON} . Due to the lower bandgap energy, the InGaAs/InP HEMT offers a lower on-state resistance compared to the other two devices, which leads to improved high-speed switching.

Figure 7 shows simulated source-

Voltronics

Frequency Control Products Inc.



TCXO
•
VCTCXO

QUICK
TURNAROUND

CUSTOM
FREQUENCY

CUSTOM
TEMPERATURE
RANGES

REASONABLE
PRICES

SMALL
QUANTITIES



THE IDEAL CHOICE FOR FREQUENCY CONTROL

Precision Temperature Compensated Crystal Oscillators (TCXOs) and Voltage Controlled TXCO's (VCTCXOs).

Voltronics FCP can provide reasonably priced frequency control products at any quantity in the quickest possible time frame. The TCXO's and VCTCXO's are offered in a number of Standard Frequencies, Temperature Stability, Input/Output and Package options, giving the designer a wide latitude in Price vs Performance criteria. Should the standard options offered not meet the designer's needs, small quantity custom parts can be provided in a reasonable time frame and often without large NRE charges.

- Wireless • PCS • GSM • PC • Telecom
- Radio Communications • Instrumentation

www.voltronicsfcp.com

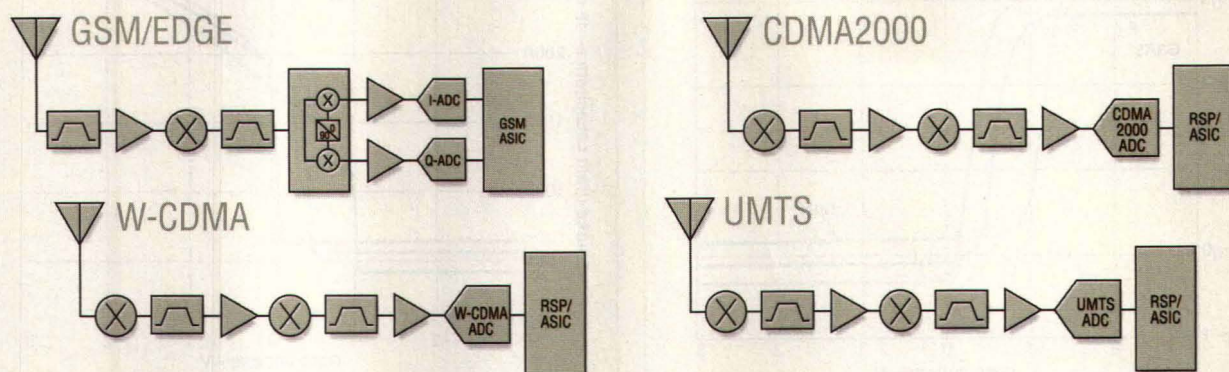
Voltronics
Frequency Control Products Inc.

100 Ford Road, Denville, NJ 07834

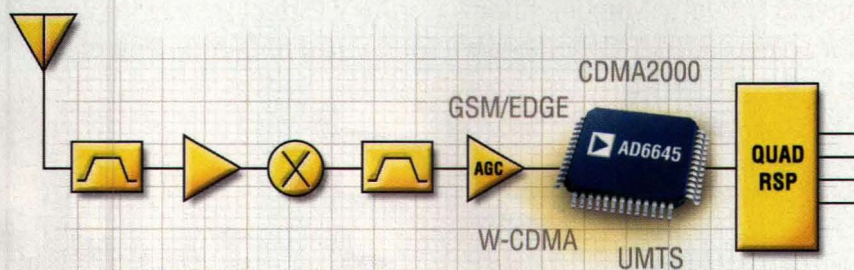
• Phone: 973-586-8585 • Fax: 973-586-3404

• Email: info@voltronicsfcp.com

Multiple air standards, multiple converters.



Multiple air standards, one converter.



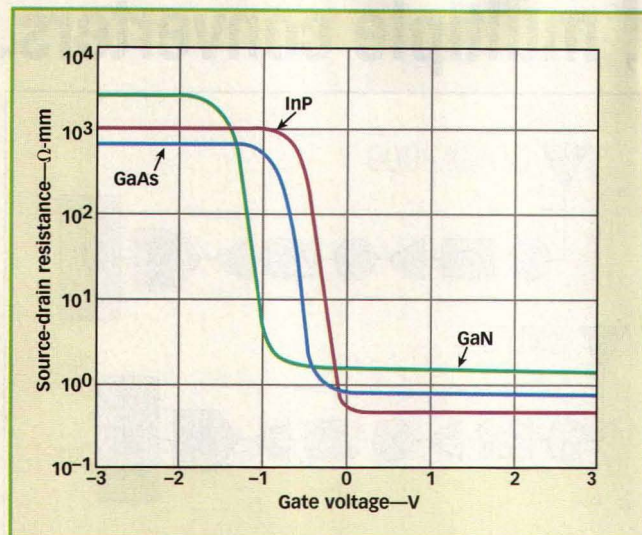
AD6645 RF Receiver ADC

Reducing part count and overall costs while increasing base station reliability has become a necessity in today's market. The AD6645 is a 14-bit, 105 MSPS ADC that enables direct IF sampling without costly downconversion stages. It achieves 100 dB multitone SFDR performance and allows users to digitize multiple air standards such as CDMA2000, W-CDMA, GSM/EDGE, and UMTS in just one chip. So, for high-speed, high-bandwidth, low-noise wireless solutions, simplify your designs with Analog Devices. *To learn more about the AD6645 and the rest of our high-performance RF IC portfolio, call 1-800-ANALOGD or visit our website.*

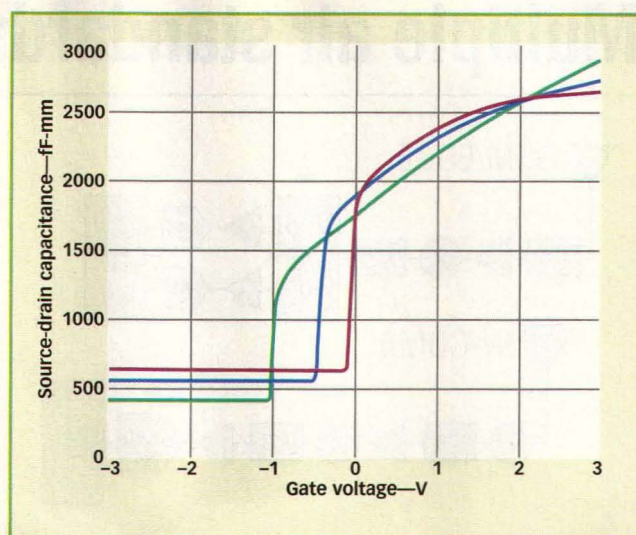
www.analog.com/rf



THE LEADER IN HIGH-PERFORMANCE ANALOG



2. Source-drain switch resistance versus gate-voltage curves are shown for InP, GaAs, and GaN HEMT switches at 1 GHz.



3. Source-drain switch capacitance versus gate-voltage curves are compared for InP, GaAs, and GaN HEMT switches at 1 GHz.

drain capacitance for three devices. Under off-state biasing conditions, the variation of C_{SD} is dominated by the extrinsic capacitances, which depend upon the FET layout. The GaN-based HEMT presents the lower C_{OFF} , because of its

low relative dielectric constant. When the on-state HEMT was biased, the total capacitance presented approximately the same variations.

Insertion loss and isolation are shown in Figs. 4 and 5 as a function of gate volt-

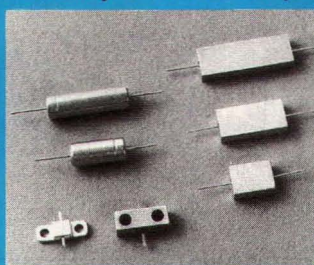
age for various technologies, for devices with a gate periphery of 200 μm . For the shunt connected switch, the InGaAs/InP HEMT switch presents a small variation on the level of insertion loss compared to the other tech-

DETECTORS WITH OR WITHOUT INTEGRAL LIMITER, OR RF AMPLIFIER

The Most Complete Detector Manufacturer -- For ANY Detector Requirement
Zero-Biased Schottky, Biased Schottky and Tunnel (Back Diode) Detectors

100 KHz TO 40 GHz

- SMA, N, K, BNC, APC-7, PIN or W/G Connections
- Coaxial, Drop-In or Bolt-Down Packages
- Integral Amplifiers, Limiters or Filters Available
- MIL-Spec or Commercial
- Custom Designs Available
- Limiter or Video Protection
- Instrument Grade High Sensitivity



ZERO-BIAS SCHOTTKY DETECTORS

DZ, DZM, DZR & DHM Series, 100 KHz to 40.0 GHz

- For Lab Testing, Power Monitoring or Leveling Circuits
- Small Size, 1.05" Long with SMA Connectors
- Connector Options: SMA, SMC, N, K, BNC & APC-7

Matched Input for DZR & DZM Series:

VSWR < 1.25:1 to 18.5 GHz
< 2.0:1 to 40.0 GHz

Extremely Flat Frequency Response:

0.3 dB to 12.4 GHz
0.5 dB to 18.5 GHz
1.0 dB to 40.0 GHz

Matched High Sensitivity DHM Series:

3 dB Higher Output Than Standard Units
1,000 mV/mW, 10 MHz to 26.5 GHz
VSWR < 1.5:1 to 18.5 GHz
< 2:1 to 26.5 GHz

Narrowband Very High Sensitivity

DZ Series:

2,500 mV/mW to 5,000 mV/mW

DT Series

Tunnel Detectors for Broadband, Zero-Bias, Wide Temperature Range Requirements
Pulse Monitor Detectors with < 2 Nanosecond Response Time

DTM Series

High Sensitivity Zero-Bias Schottky Detectors Give 3 dB More Output

DHM Series

Biased Schottky Detectors for High Sensitivity and Dynamic Range
Limiter-Detectors to 1 Watt Input

DS Series

DSL Series

Herotek

The Detector Specialists -- Please Call for Detailed Brochures

COMB GENERATORS • LIMITERS • SWITCHES • GaAs FET AMPLIFIERS • SUBSYSTEMS

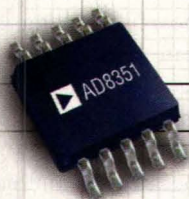
155 Baytech Drive • San Jose, CA 95134-2303 • PH 408-941-8399 • FAX 408-941-8388
E-Mail: Info@Herotek.com Web Site: <http://www.herotek.com> Visa/MasterCard Accepted



Drives you crazy frequently.



Drives your ADCs at high frequency.



Up to 240 MHz

Only from Analog Devices

Features

- 2.2 GHz bandwidth (–3 dB gain 12 dB)
- Lowest distortion –80 dBc @ 70 MHz
- Low input noise 2.3 nV/√Hz
- Adjustable output common-mode voltage
- Excellent settling and overdrive recovery
- A single 3 V to 5 V supply drawing only 27 mA

Benefits

- Improve performance
- Lower chip count
- Use less board space
- Consume less power
- Simplify designs
- No tweaking required

AD8351 RF/IF Amplifier

Don't settle for cumbersome single-ended to differential solutions. The AD8351 is a low distortion amplifier optimized for driving high speed and high resolution sampling converters up to 240 MHz. And, unlike other discrete solutions, this single chip makes it easy to set the gain (from 0 dB to 30 dB) with a single resistor, match the common mode to the ADC, and at the same time provide the lowest distortion and noise to maximize ADC dynamic range.

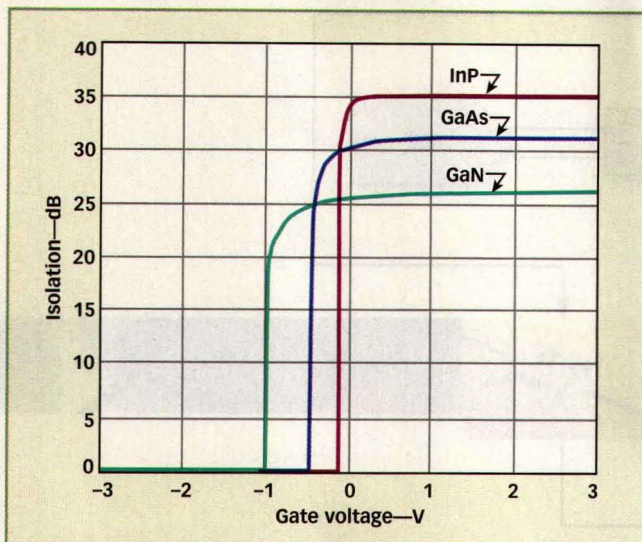
For more information on the AD8351 and the rest of our high performance RF IC portfolio, visit our website.

www.analog.com/rf

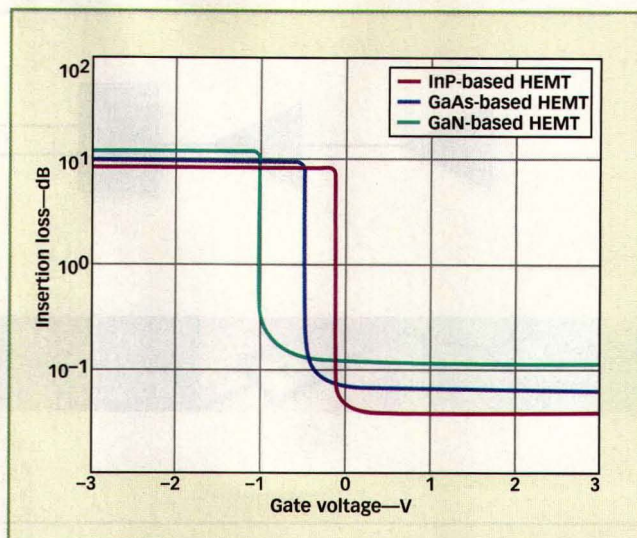


**ANALOG
DEVICES**

THE LEADER IN HIGH PERFORMANCE ANALOG



4. Shunt connected switch loss versus gate-voltage curves are shown for InP, GaAs, and GaN HEMT switches at 1 GHz.

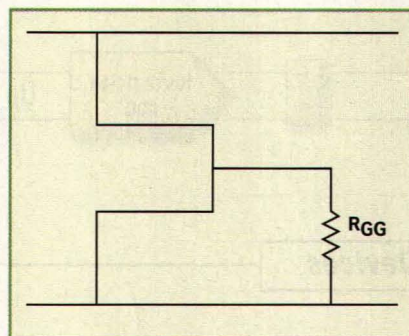


5. Series connected switch loss versus gate-voltage curves are compared for InP, GaAs, and GaN HEMT switches at 1 GHz.

nologies, but demonstrated an improvement of isolation of 4 dB than GaAs-based HEMT and 9 dB than the GaN-based HEMT switches due to lower on-state resistance. The converse is true in the series case, where the isolation is approximately constant. The insertion losses of the three technologies are low, due the low on-state resistances of the InGaAs/InP, AlGaAs/GaAs, and AlGaIn/GaN HEMT switches.

The power-handling characteristics of each technology in microwave control applications were also investigated. To define the total resistance and the

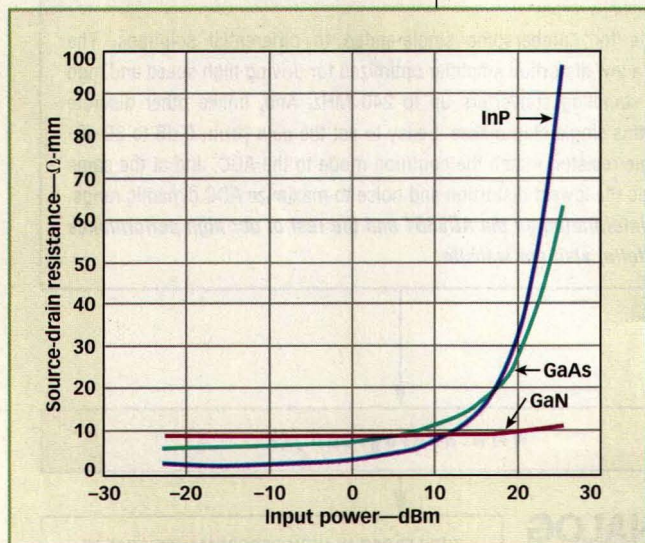
total capacitance in large-signal environment, a simple equivalent circuit of



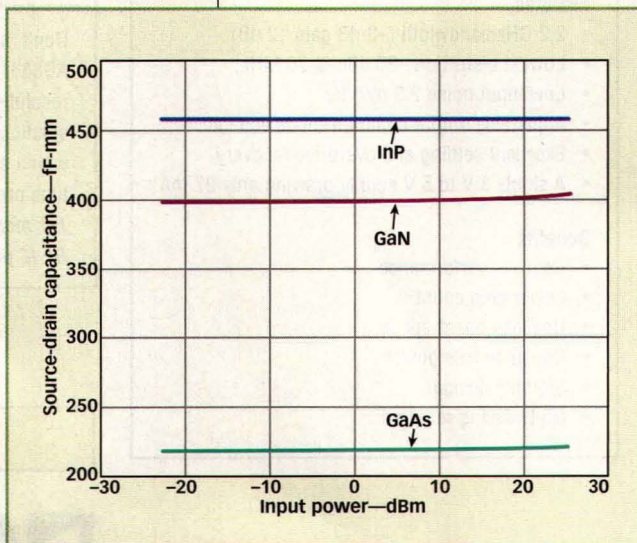
6. This simple diagram shows a shunt HEMT switch configuration.

the shunt HEMT switch was used (Fig. 6). For a broadband HEMT switch, power handling is dependent on the gate-bias circuitry. For improved isolation of the gate-control voltage, the gate is usually biased with a large gate-bias resistance, R_{GG} , or a resistor incorporated monolithically within the gate.

Figures 7 and 8 show the variations of R_{SD} and C_{SD} , respectively, with input power for the three types of HEMT switches at 1 GHz. When the on-state HEMT was biased, the on-state resistance increases with increasing input power. *Continued on p. 71*



7. On-state resistance versus input power curves are shown for the three switches at a gate voltage of 1 VDC at 1 GHz.



8. On-state capacitance versus input power curves are shown for the three switches at a gate voltage of 1 VDC at 1 GHz.

HIGH performance

Microstrip *Low cost* VCO

MFC, VCO & VFC Series

Microstrip resonator based offering superb phase noise performance and bandwidth from optimized to over an octave frequency generation.

Frequency range: 40 MHz to 6100 MHz

TFC Series

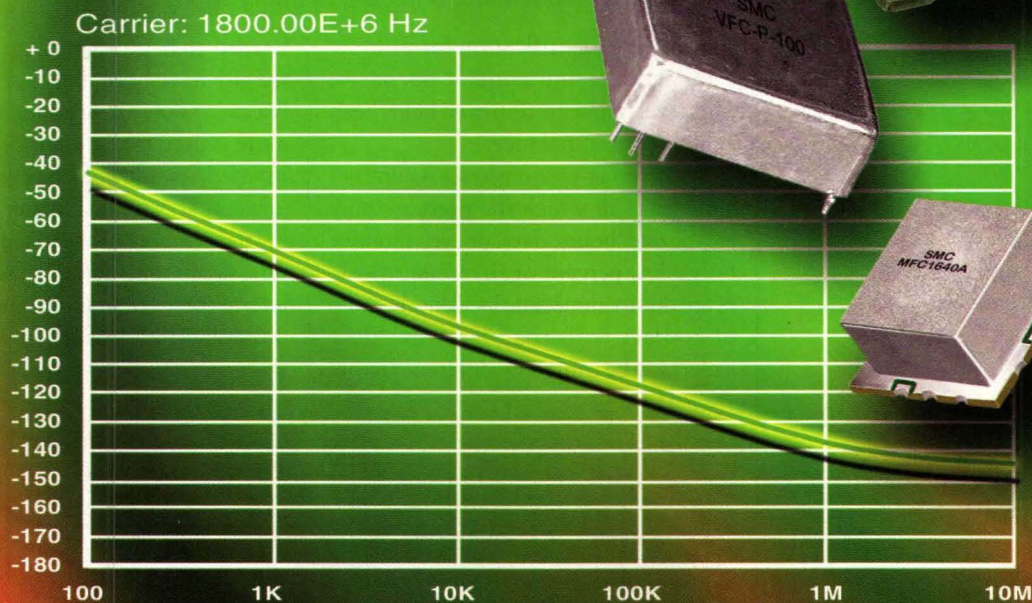
Microstrip resonator based and miniature style package for optimized bandwidth.

Frequency range: 100 MHz to 3000 MHz

Series 5

Dual isolated output with excellent phase noise and good stability

Frequency range: 50 MHz to 1000 MHz
(optimized bandwidths)



For additional information, contact Synergy's sales and application team.

201 McLean Boulevard, Paterson, NJ 07504

Phone: (973) 881-8800 Fax: (973) 881-8361 E-mail: sales@synergymwave.com

World Wide Web: www.synergymwave.com



Wireless Approach Monitors Tire Pressure

Several methods are available for remote monitoring the air pressure of vehicle tires, but highly integrated wireless circuits may offer the most reliable and accurate solutions.

Tire-pressure monitoring (TPM) is among the more useful, albeit humble, of wireless applications. Although application-specific integrated circuits (ASICs) have been commonly used for TPM functions, several integrated solutions from Atmel (San Jose, CA) can simplify the addition of wireless TPM functions to automotive telematics systems. These ICs are available with adequate on-board memory to

such as natural leakage, permeation, or seasonal climatic changes. Furthermore, slight damage to a tire by a road

support tire identification for production, service, and control purposes. This level of integration even helps keep vehicle tires in balance.

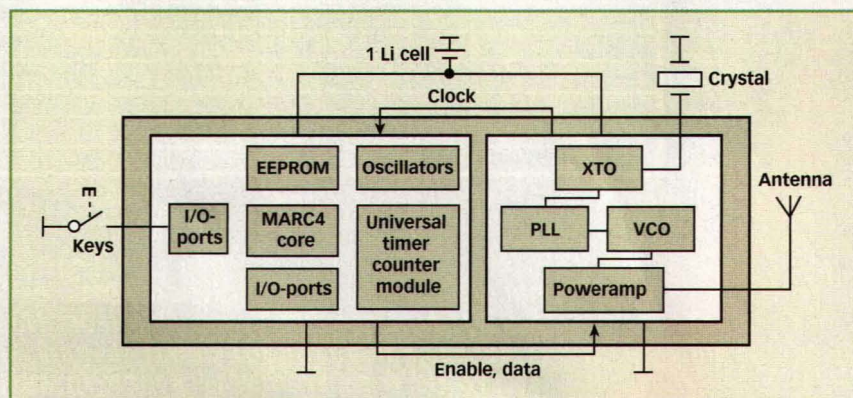
Most tire air-pressure losses occur from slow leaks in which the pressure may escape over hours, days, or even months; only a few percent of air-pressure losses are due to immediate incidents because of contact with road hazards. Slow leaks may be caused by different factors

hazard that punctures small holes in the tire have been detected as a typical reason of slow air-pressure losses. When a tire is used while significantly under-inflated, its sidewalls flex more and the air temperature inside increases, making the tire more prone to failure. In addition, significantly under-inflated tires lose lateral traction, making handling more difficult. High-quality tires with optimum air pressure are equivalent to a life-

MARTIN MOTZ

Marketing Manager

Atmel Germany GmbH, 74072 Heilbronn, Theresienstrasse 2, Germany; (49) 7131-67-2790, FAX: (49) 7131-67-2777, Internet: www.atmel.com.



1. This block diagram of the T48C862/ATAR862 module shows the ATAM893 and T575x ICs requiring only a low-cost crystal, external antenna, and power supply (battery) for a complete TPM system.

UMTS / CDMA-3G Band **SYNTHESIZER**

- ◆ 2110 to 2170 MHz
- ◆ Exceptional Phase Noise
- ◆ Compact Size
- ◆ Optimized Reference Sidebands



New

*For additional information, contact Synergy's sales and application team.
201 McLean Boulevard, Paterson, NJ 07504
Phone: (973) 881-8800 Fax: (973) 881-8361 E-mail: sales@synergymwave.com
World Wide Web: <http://www.synergymwave.com>*





Quiet DROs for Clear Communication.

The desire for low noise Dielectric Resonator Oscillators to enhance clear communication, spectral purity, continues. Typical phase noise @ 100 KHz offset of -126 dBc/Hz for 10 GHz, -120 for 20 GHz and -114 for 40 GHz are being measured on our production DROs. Harmonics measured between -45 dBc and -50 dBc. Spurious are less than -85 dBc.

- No Phase Hits
- No Microphonics
- No Data Gaps

- No Interruptions
- Just Clear, Reliable Transmission

Check the Lucix Website for outstanding features of our DROs, such as low power consumption, very small size, high output power, ultra stability. Tell us your special needs.



*Quieter Than
Ever Before*

At Lucix, we listen!

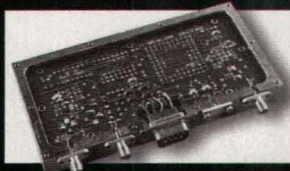


800 Avenida Acaso, Unit E • Camarillo, CA 93012 • Tel: 805.987.6645 • Fax: 805.987.6145
www.lucix.com

SAW FOR DEFENSE AND SPACE

SAW components and subsystems for IF signal processing in military and professional OEM equipment.

Engineering support and unique design capabilities enable prototype development allowing more competitive NRE pricing and quick delivery.



Phonon
CORPORATION

COMMUNICATIONS: IF bandpass filtering for: cellular base stations, microwave links, mobile digital radio, MSK matched filters.

RADAR: Wide band matched filters, pulse compression using bi-phase, linear and non-linear frequency modulations.

ELECTRONIC WARFARE: Real time spectrum analysis, channelized filter banks, delay lines.

SPACE: High reliability SAW components for satellite use.

PHONON CORPORATION

P.O. Box 549
90 Wolcott Road, Simsbury, CT 06070
Tel: (860) 651-0211 • Fax: (860) 651-8618
www.phonon.com • saw@phonon.com

insurance policy for drivers, passengers, and the vehicles themselves. Tire-related problems account for many vehicle breakdowns. Most drivers do not regularly monitor their tires, inviting dangerous conditions.

To identify slow pressure leaks and to guarantee that the driver will be warned, two automotive TPM methodologies have evolved during the past 15 years: indirect sensing systems and direct sensing systems. In the first type, the tire pressure is evaluated based on the rotational speed of a vehicle's wheel relative to the other wheels. These systems—usually linked to an automatic braking system (ABS)—compare the rotation of the wheels to determine if a wheel is under-inflated. In direct sensor systems, encapsulated tire module boards contain pressure and temperature sensors to perform an on-going series of measurements on the tire pressure and temperature. These modules are mounted in the wheel and transmit an RF signal containing the tire-pressure and temperature information to a central receiver (Rx) in the vehicle.

Early TPM systems were introduced with the indirect sensing method. The differential speed detection of the indirect pressure sensing system has several inherent weaknesses, including the fact that the loss of tire pressure cannot be detected for all four tires at a similar rate. Even monitoring two tires on the same side or axis can result in ambiguous results. In addition, the correlation of tire temperature to air pressure is not included in the indirect method, and drop in tire pressure of less than 15 percent cannot be detected with the indirect method. A system calibration time of several minutes and up to hours would be needed to teach the variables associated with distinct tire types at differential driving preconditions. The detection of under-inflated tires itself requires several minutes. The detection and determination of which tire is under-inflated is an unsolved problem. An incorrect indication of under-inflated tires has been found in certain circumstances.

Direct-sensor TPM systems have been developed to overcome the limi-

EIGHT WAYS TO JUMP START YOUR DESIGN

WITH GENESYS V8 SYNTHESIS

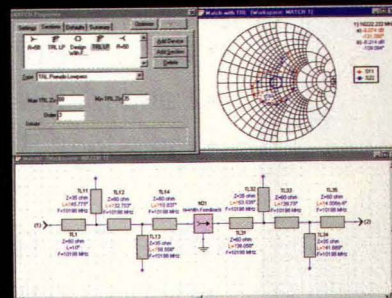
From Start To Finish. You're in the driver's seat with GENESYS V8's winning synthesis modules for amplifiers, oscillators, PLLs, filters and more. Need to design an x-band amplifier for example? Choose your transistor and start your engines.

The First Two Ways Make It Easy!

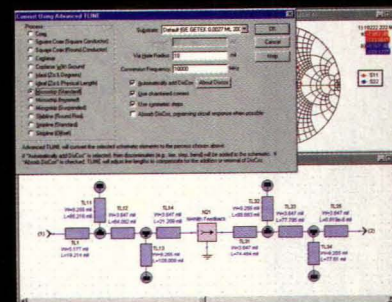
1. Use our MATCH module to synthesize your amplifier matching circuit. Simply enter your device models and matching network topologies and MATCH calculates the network parameters needed for an optimal match between source and load.

2. Then use ADVANCED T/LINE to automatically convert schematics between ideal, microstrip, stripline, coplanar and transmission line types. You'll jump start your design without even switching gears.

So Grab a Seat and Hold On! And get the extra power, speed and accuracy you need. With synthesis packages starting under \$3,000 US, you'll land the pole position every time.



MATCH synthesizes networks



T/LINE transforms into stripline, microstrip, coplanar and others

Phone: +1 678-291-0995

sales@eagleware.com

E
EAGLEWARE
RF and Microwave Design Software

www.eagleware.com

Fax: +1 678-291-0971

tations of indirect sensing systems. Dedicated tire-pressure monitoring is now possible, even when all four wheels are involved. The tire-pressure monitoring can also operate when the vehicle is stationary. Smooth pressure decrease can be monitored easily.

Advances in direct-sensor circuitry has enabled these modules to run under battery power with low current consumption, and new technologies that use RF energy supplied from the car body module, thus avoiding a battery supply, are in development.

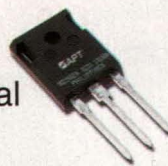
RF Transistors



Previously GHz Technology
Microsemi RF Division
RF Business of APT

Serving These Markets

- Avionics
- Radar
- HF, VHF, UHF Communications
- Broadcast
- Microwave
- Microwave Broadband
- General Purpose & Small Signal
- Land Mobile Communications
- Industrial, Scientific, & Medical (ISM)



with a Full Range of Technologies

- Bipolar, VDMOS, and LDMOS

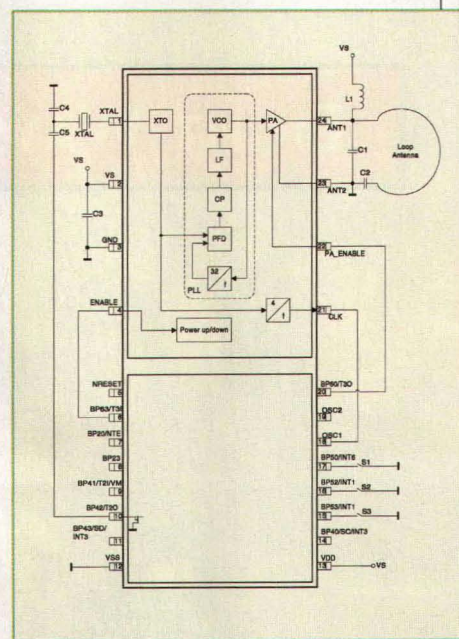


and Providing Unique Benefits

- "One Stop Shopping".... with a full lineup for your power amplifier.
- Highest Output Power
- Highest Operating Voltage
- Lowest Cost of Ownership ... we test the performance in your circuit.



California Pennsylvania
Tel: (408) 986-8031 Tel: (215) 631-9840
www.advancedpower.com



2. This package diagram of the T48C862/ATAR862 module shows the pin assignments for the two ICs, including connections for an external loop antenna.

Currently, microcontrollers are becoming more relevant to improving the tire-pressure monitoring solution in tire modules. Flexibility of the system definition is becoming an important requirement for production and service resulting in the integration of the electronically erasable programmable-read-only memory (EEPROM). The EEPROM can also be used for the programming of the tire-identification (ID) code during tire installation.

Due to battery-life requirements, the power consumption of the tire-pressure module is a key performance requirement. Currently, standby or sleep modes along with duty cycling of the RF transmission are used to obtain the lowest power consumption. However, no matter how successful these different techniques are, market focus will continue to be on the development of a TPM IC with even lower current consumption. Furthermore, TPM module systems must be optimized for minimum weight, size, and cost. These improvements will lead to a higher acceptance of the direct TPM approach, allowing the introduction of direct TPM into new vehi-



Thursday: 3:20 pm
Windsurfing off the coast

We know you have better things to do...

The RFMD® Advantage

High-performing, reliable, low-cost solutions

Broad technology base

Industry-leading capacity

Design expertise

Knowledgeable sales team

Application and design support

On-time delivery

Our communication solutions will give you a whole new perspective.

RF 
MICRO-DEVICES

Providing Communication Solutions™

RF Radio Wireless LAN Bluetooth™ Infrastructure Wireless Handsets CATV PCS Systems

www.rfmd.com

Visit Us At CTIA Booth #3949

ISO 9001: 2000 Certified
ISO 14001: 1996 Certified

RF MICRO DEVICES®, RFMD®, Optimum Technology Matching® and Providing Communication Solutions™ are trademarks of RFMD, LLC. BLUETOOTH is a trademark owned by Bluetooth SIG, Inc., U.S.A. and licensed for use by RF Micro Devices, Inc. © 2003 RF Micro Devices, Inc.

cle models with a high adoption rate.

All of the silicon (Si)-based ICs and components needed to construct TPM ultra-high-frequency (UHF) communications channels are available from Atmel. The firm currently supplies components to several commercial TPM

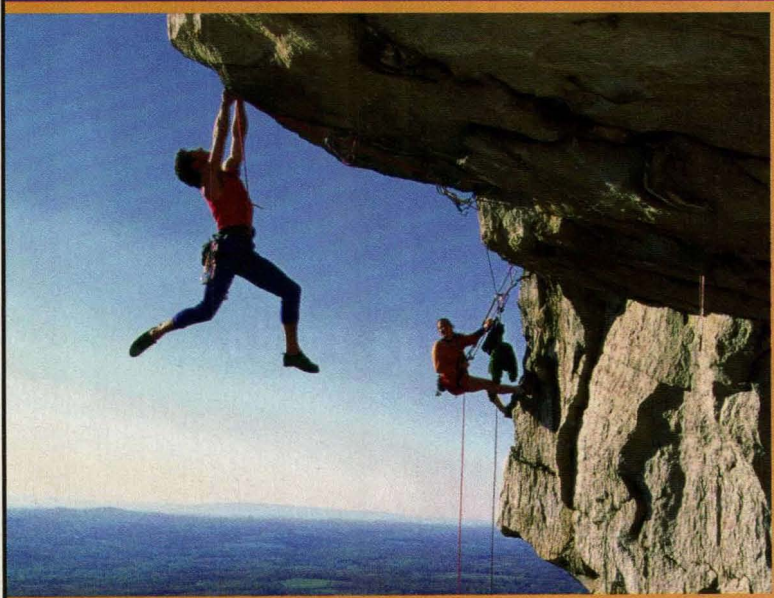
module platforms. For example, the company's model AT86RF401 is an AVR-based 8-b microcontroller with integrated UHF phase-locked-loop (PLL) transmitter (Tx) designed for amplitude-shift-keying (ASK) modulation supplied as a single complementary-

metal-oxide-semiconductor (CMOS) device. Ideal for direct-sensing TPM applications, the device is housed in a TSSOP20 package. It is capable of maximum transmit power of +6 dBm, and offers a 36-dB RF output-power control range, adjustable in 1-dB steps. The device is specified for reliable operation over typical automotive temperature ranges. It is available as a flash version and requires only a crystal resonator, three capacitors, an inductor, and a tuned loop antenna to implement a complete on-off-keyed (OOK) UHF Tx operating in the 264-to-456-MHz frequency range. The IC is typically powered by a single lithium (Li)-type coin-cell battery and designed to operate with minimum voltage of +2 VDC.

The company also offers the model ATAR862 integrated TPM module (Fig. 1) as a customized mask read-only-memory (ROM) version supplied in a SS024 package. The device's EEPROM enables ID programming for optimum production and service flexibility (Fig. 2). The device, with integrates control and Tx functions, supports both ASK and frequency-shift-keying (FSK) transmit modulation formats for further flexibility. It meets extreme TPM operation temperature conditions up to +125°C combined with lowest possible current consumption of 0.4 μ A in sleep mode supported by the unique power-down modes of the 4-b Atmel microcontroller. The silicon bipolar Tx achieves +10-dBm maximum output power and beneficial spurious emission parameters of -52 dBm. It is also available in a pin-compatible flash version.

In addition, Atmel's T5753/52 PLL Tx IC is available in an eight-pin TSSOP8 package for all direct-sensing TPM frequency ranges. The PLL, which is well suited for used with a single-ended antenna, provides frequency stability and accuracy at UHF when operating with a low-cost crystal resonator; it requires only seven additional external components. The Tx is flexible enough to operate with voltages from +2 to +4 VDC; a version for use at +1.9 VDC is also available. **MRF**

Why risk it?



Your system is only as reliable as the components you use.

Why risk a great design on anything less than the world's highest reliability resistors? State of the Art resistors.

- Unsurpassed established reliability failure levels for MIL-PRF-55342 chip resistors, including "S" level (0.001% per 1,000 hours) and "T" (space) level
- Exclusive MIL-PRF-914 surface mount network qualification

■ Full range of thick and thin film resistive products ideal for

- Medical electronics
- Defense systems
- Microwave communications
- Aerospace electronics
- Satellite systems



State of the Art, Inc.

Reliable Resistors

2470 Fox Hill Road • State College, PA 16803-1797

Call Toll Free: 1-800-458-3401

Fax: 814-355-2714 • e-mail: sales@resistor.com

www.resistor.com

50 million parts in stock!





802.11a 802.11g
802.11b 802.11a/b/g

highly integrated

small size
solution

low power

cost effective

high performance

...than to worry about your next WLAN solution.

Introducing our complete WLAN solutions for all 802.11 standards - designed to meet your customers' demands for high-speed wireless connectivity. From 2.4 GHz WLAN solutions to advanced 5 GHz and multi-mode two-chip CMOS solutions, our chipsets easily integrate into wireless clients as well as specialty modules in consumer electronic devices, access points and commercial/residential gateways. Our applied wireless networking knowledge and innovative technologies in RF CMOS, baseband/DSP, Media Access Control (MAC), protocol stack software and power amplifier design enable us to deliver highly optimized products for end-to-end wireless networks. In addition to our comprehensive WLAN product portfolio, RF Micro Devices provides extensive applications support as well as reference designs and support documentation.

Our complete WLAN solutions will give you more free time to play in the surf.



**Dual Band 802.11a/b/g
(2.4GHz and 5GHz)**

- **RFC55420** 2-chip complete chipset solution
- **RF5425** single chip dual-band 1.8V CMOS radio
- **RF5421** multi-protocol baseband/MAC IC
- **AccuChannel™** equalization for greater range
- Flexible MAC architecture
- On-chip high speed ARM922T with cache
- WEP, TKIP, 802.1x, AES support

**802.11a
(5GHz)**

- **RFC55400** 2-chip complete chipset solution
- **RF5405** single chip 5GHz 1.8V CMOS radio
- **RF5401** integrated baseband/MAC IC
- **AccuChannel™** equalization for greater range
- Flexible MAC architecture
- On-chip high speed ARM922T with cache
- WEP, TKIP, 802.1x, AES support

**802.11b
(2.4GHz)**

- **RF2958** low-cost, high-performance single chip radio
- **RF5189** internally matched high-efficiency PA
- **RF3002** small size, enhanced performance baseband
- Minimal external components
- Low power and small size for embedded applications

**802.11g
(2.4GHz)**

- Single-chip radio
- Power amplifier

For sales or technical support, contact RF Micro Devices at
336.678.5570 or **callcenter@rfmd.com**.

RF 
MICRO-DEVICES

Providing Communication Solutions™

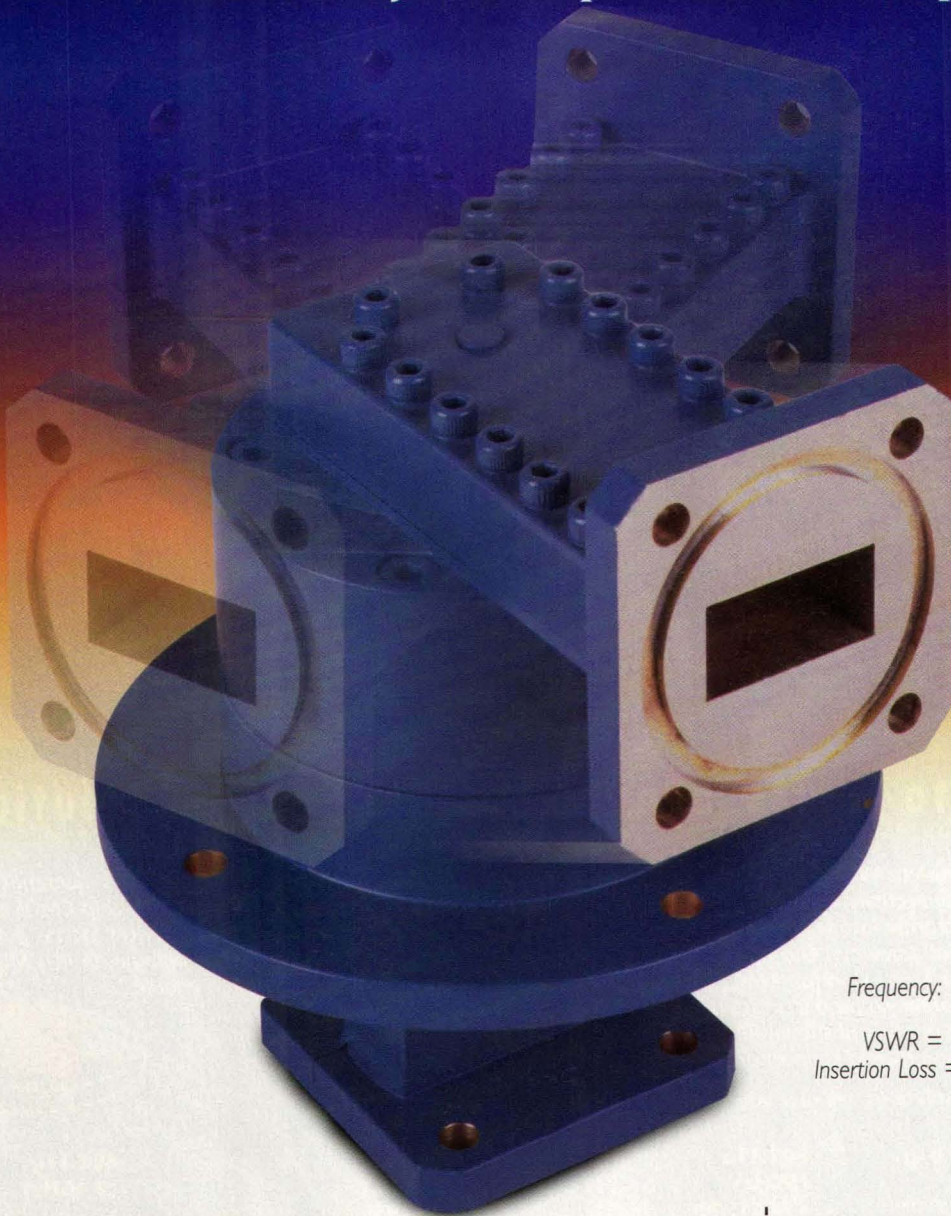
CDMA CDMA2000 EDGE GPRS GSM IEEE 802.11 TDMA UMTS WCDMA

www.rfmd.com

Visit Us At CTIA Booth #3949

RF MICRO DEVICES® RFMD®, AccuChannel™ and Providing Communication Solutions™ are trademarks of RFMD, LLC. © 2003 RF Micro Devices, Inc.

Let us take your specs for a spin.



Frequency: 14.0 – 14.5 GHz
10.75 – 12.75 GHz
VSWR = 1.20 MAX
Insertion Loss = .20 Db MAX

Custom Dual Band Rotary Joints

As the demand for higher frequencies and broader band widths grow, MDL engineers stay a step ahead. With the very latest in SolidWorks, Ansoft HFSS, and our own proprietary software, we'll design and build precision dual band rotary joints to your size and specs in impressively little time.

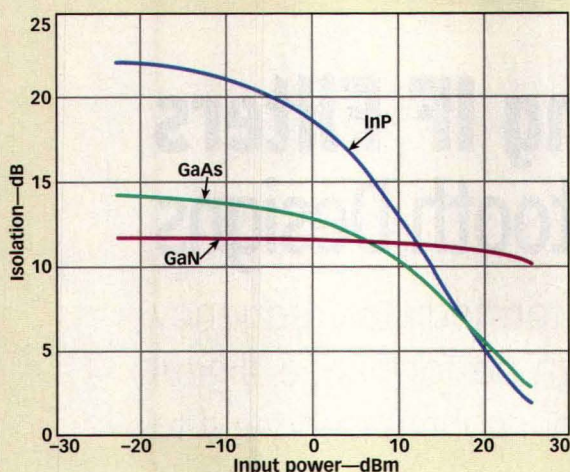
Call us.

Quality from CAD to crate is what has made us the industry's largest manufacturer of high quality cast components and waveguide packages. Call an MDL specialist today at 800-383-8057 or visit us at mdllab.com.

WAVEGUIDE CAST BENDS & TWISTS
WAVEGUIDE FEED ASSEMBLIES
MONOPULSE COMPARATORS
ROTARY JOINTS
MICROWAVE FILTERS
ROTARY SWITCHES
WAVEGUIDE TO COAX ADAPTERS
WAVEGUIDE PRESSURE WINDOWS
COMMERCIAL WAVEGUIDE ASSEMBLIES



Microwave Development Laboratories, 135 Crescent Road, Needham Heights, MA 02494
V: 781-292-6680/6684 F: 781-453-8629 E-mail: mdlsales@mdllab.com www.mdllab.com



9. Power-dependent HEMT switch isolation is shown for a variety of temperatures at a characteristic impedance of 50 Ω , frequency of 1 GHz, and gate voltage of +1 VDC.

Continued from p. 60

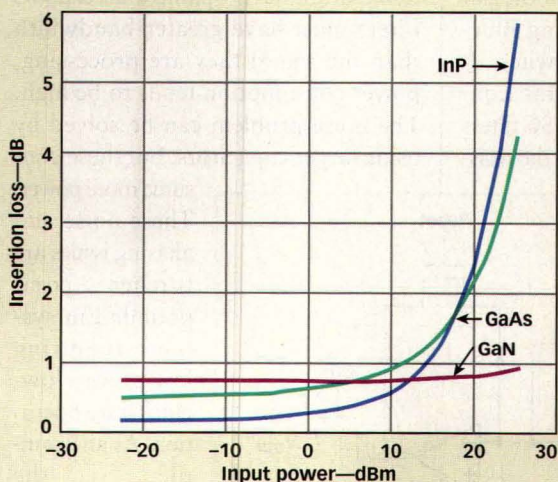
power above +5 dBm for both the InP- and GaAs-based HEMT switches and above +15 dBm for the GaN-based HEMT switch. Figure 8 shows that the on-state capacitance varies with increasing input power above +15 dBm for the GaN-based HEMT switch, and no degradation of this capacitance was observed for inputs to +25 dBm for the two other technologies.

Figures 9 and 10 show the variations of shunt-connected HEMT isolation

and series-connected HEMT insertion loss, respectively, with input power for the three technologies at 1 GHz. The effect of input power isolation and insertion loss was evaluated under on-state biasing conditions of $V_g = +1.0$ VDC. For both the InP- and GaAs-based HEMT switch technologies, there are strong degradations of isolation and insertion loss with increasing level of input power above 0 and +3.5 dBm, respectively. Compared with the AlGaIn/GaN HEMT

switch, the same phenomenon occurs at power levels above +15 dBm due the wide bandgap of the GaN material. This result shows the feasibility of using AlGaIn/GaN HEMTs for high-power microwave control.

Table 2 summarizes cutoff frequencies and breakdown voltages calculated by the relationship from ref. 6. These cutoff-frequency results are based on a gate periphery $W = 200 \mu\text{m}$ and a gate bias voltage of -2 VDC (C_{OFF}) and +2 VDC (R_{ON}). **MRF**



10. Power-dependent HEMT switch insertion loss is shown for a variety of temperatures at 50 Ω , frequency of 1 GHz, and gate voltage of +1 VDC.

switch, the same phenomenon occurs at power levels above +15 dBm due the wide bandgap of the GaN material. This result shows the feasibility of using AlGaIn/GaN HEMTs for high-power microwave control.

REFERENCES

1. J.L. Cazaux, D. Pavlidis, G.I. Ng, and M. Tutt, "A HEMT monolithic double channel attenuator with broadband characteristics and wide dynamic range," 18th European Microwave Conference, September 1988, pp. 999-1004.
2. E. Alekseev, Shawn S.H. Hsu, and D. Pavlidis, "Broadband AlGaIn/GaN HEMT MMIC Attenuators with High Dynamic Range," the 30th European Microwave Conference.
3. N. Jain and R. Gutmann, "Modeling and Design of GaAs MESFET control devices for Broad-Band Applications," *IEEE Transactions on Microwave Theory & Techniques*, Vol. 38, February 1990, pp. 109-117.
4. N.V. Drozdovski, R.H. Caverly, and M.J. Quinn, "Large-Signal Modeling of Microwave Gallium Nitride-Based HFETs," 2001 AP MC, Taipei, Taiwan, December 3-6, 2001, Proceedings of APMC'01, Vol. 1, pp. 248-251.
5. R.H. Caverly, N.V. Drozdovski, and M.J. Quinn, "Gallium Nitride-Based Microwave and RF Control Devices," *Microwave Journal*, Vol. 44, No. 2, February 2001, pp. 112-124.
6. S.H. Wemple, W.C. Niehaus, H.M. Cox, J.V. DiLorenzo, and W.O. Schlosser, "Control of gate-drain avalanche in GaAs MESFETs," *IEEE Transactions on Electron Devices*, Vol. ED-27, 1980, pp. 1013-1018.

TELECOM AMPLIFIERS



RF and Microwave Low Noise Amplifiers
High Dynamic Range Amplifiers
Dividers / Combiners
Integrated Subsystems
Medium Power Amplifiers
Multicouplers
Up / Down Converters

CAP Wireless

(805) 499-1818
www.capwireless.com

Sampling IF Filters Fortify Bluetooth Designs

The sampling intermediate-frequency (IF) filter is a high-performance digital device that can bring increased yield to integrated Bluetooth receiver designs.

bluetooth system architects strive to reduce cost, component count, and power consumption while maintaining high production yields for both chips and modules. Traditionally, the first three requirements are met by integrating off-chip components. However, a high level of analog integration adversely affects chip yield. Because of market demands for reduced cost and low component counts, Bluetooth is a

prime example of a system-on-a-chip (SoC) technology reaching higher levels of integration. As an alternative low-power approach, it is possible to integrate intermediate-frequency (IF) filters in a Bluetooth receiver (Rx) for increased yield over other techniques.

Two well-known filter technologies have been used for integrating Bluetooth IF filters on chip: the switched-capacitor (SC) filter and the transconductor-capacitor (gm-C) filter. SC filters are constructed by substituting the resis-

tors in an active RC filter with switches and capacitors. These SC filters have very precisely defined bandpass characteristics because the time constants associated with the frequency response depend only on the capacitor ratios and the clock frequency. A serious drawback with using SC filters in an IF stage is the danger of aliasing interfering signals. Since the operational amplifiers (opamps) used in SC filters must have greater bandwidth than the signal they are processing, power consumption tends to be high. The noise problem can be solved by using larger capacitors, but these consume more power.

These noise and aliasing issues are further compounded in systems requiring low-power, low-clock-rate operation. As an example,¹ the signal-to-noise ratio (SNR) of one SC filter was 31 dB, which is the

SESTE DELL'AERA

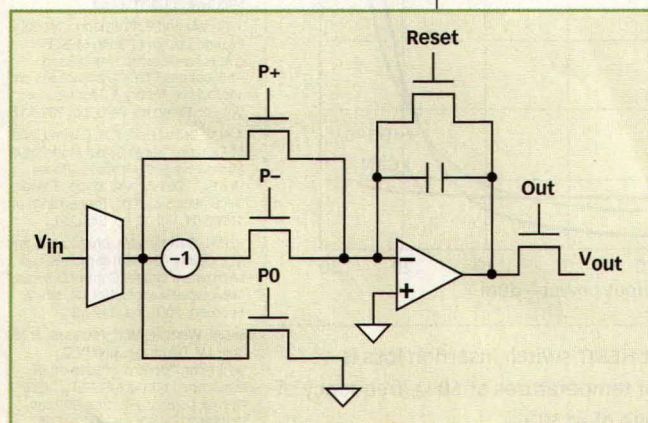
Vice-President of Sales and Marketing

TOM RILEY

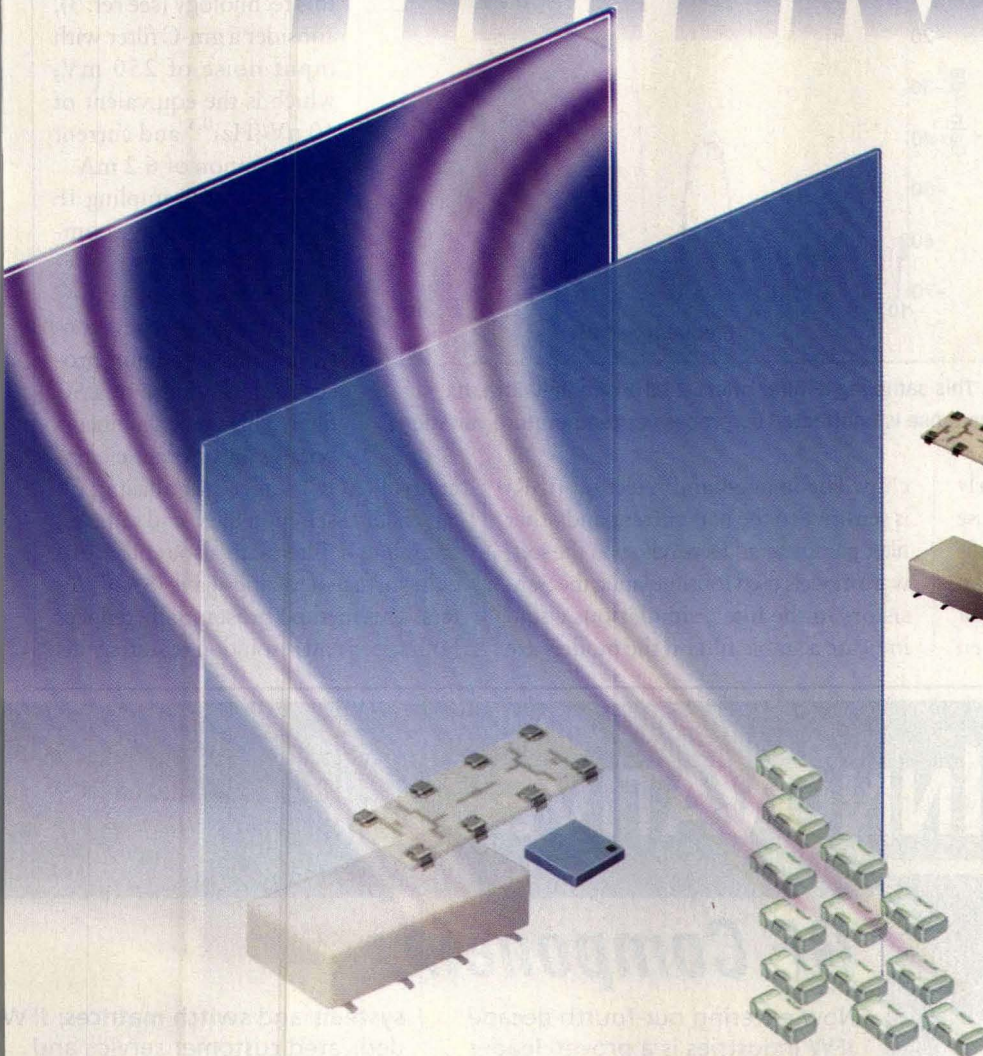
Chief Executive Officer

Kaben Research, Inc., Ottawa, Ontario, Canada; (613) 826-6649, FAX: (613) 826-6650, e-mail: seste.dellaera@kabenresearch.com, Internet: www.kabenresearch.com.

1. This block diagram shows a single-ended version of a sampling IF filter, although the approach usually involves differential circuitry.



FILTERS



LTCC .12"x.06"
LFCN (low pass)
5 models DC-2400MHz

LTCC .15"x.15"
LFTC (low pass)
7 models DC-5400MHz
HFTC (high pass)
5 models 1300-7000MHz

LTCC .7"x.3"
LPCH (low pass)
4 models DC-900MHz

Discrete .7"x.3"
SCLF (low pass) 24 models
DC-1000MHz
SALF (low pass) 11 models
DC-865MHz
SCHF (high pass) 3 models
18-1200MHz

4.7MHz to 10GHz from **99¢** ^{IN STOCK}
ea. qty. 1000
10 pcs. \$1.99 ea.

Using leading edge Low Temperature Co-fired Ceramic (LTCC) technology, Mini-Circuits has introduced an extensive variety of new Blue Cell™ filters giving you the advantages of smaller size, excellent repeatability, and high power handling at very low cost. Choose from units as small as a chip resistor, a mere 0.12"x0.06" in size, rejection frequency bands up to 5GHz, and prices from less than \$1. Other models offer superb performance up to 10GHz. In addition, take your pick from over 35 discrete component models offering wide bandwidths and cut-off frequencies as low as 4.7MHz, all at industry low prices with immediate off-the-shelf availability. You can quickly find the model you need on our web site through the "online catalog" and "new products" links. If you have requirements not shown, ask us! We will let you know right away if we can do it and have it for you within 2 weeks. So contact Mini-Circuits today. Our team is ready to work with you worldwide!

Mini-Circuits...we're redefining what VALUE is all about!



P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

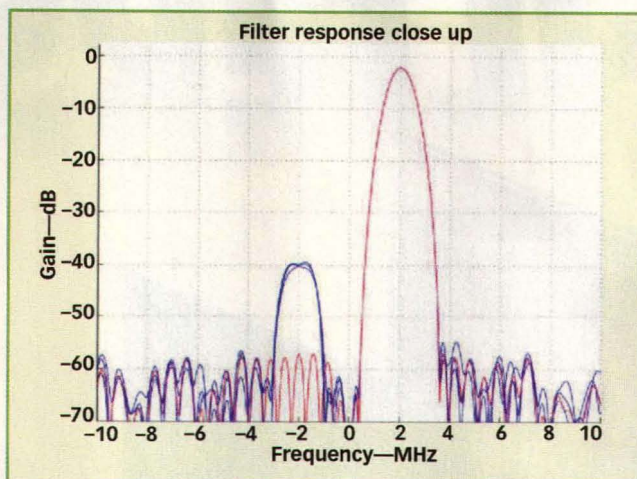
ISO 9001 ISO 14001 CERTIFIED

390 Rev B

See our 244 page RF/IF Designer's Guide in EEM (Electronic Engineers Master)

equivalent of $14 \text{ nV}/(\text{Hz})^{0.5}$ and a current consumption of 10 mA.

A gm-C filter is constructed by replacing the inductor (L) in an LC filter with a capacitor and a gyrator made from a transconductance amplifier. Typically, gm-C filters provide lower noise and lower-power operation than SC filters but suffer in two problem areas where SC filters perform better. There is typically a trade-off where gm-C filters require more power to provide adequate linearity. Since the time constants in a gm-C filter depend on two independent process variables (gm and C), they tend to have poorly controlled passband frequency response characteristics unless a process calibration loop is included. This can adversely effect the chip yield and result in additional wafer runs for a given



2. This sampling IF filter offers 2 MHz of bandwidth. Its response is unaffected by process or temperature variations.

chip. The image-band rejection (IBR) is sensitive to the bias current and other filter parameters.² Depending on the software models used for simulating the transistors in the filter, simulations could indicate a stable filter if the models are

too simple. Once fabricated, the filters could still be unstable. As an example of this technology (see ref. 3), consider a gm-C filter with input noise of 250 mV, which is the equivalent of $10 \text{ nV}/(\text{Hz})^{0.5}$ and current consumption of 6.2 mA.

The new "sampling IF filter" technology, combines the low-power, low-noise properties of a gm-C filter with the precisely controlled passband and process independence of a SC filter. This single unit incorporates an automatic-gain-control (AGC) stage, anti-aliasing filter, channel-selection filter, and sampler. Sampling IF filters can also replace off-chip surface-acoustic-wave (SAW) filters. This method substantially reduces both speed and resolution requirements



INNOVATIVE.

RF Components

Now entering our fourth decade, JFW Industries is a proven leader in the design and production of **innovative** RF solutions. Whether your project calls for **fixed attenuators** and **terminations**, **manually** and **electronically controlled attenuators**, **RF switches**, **power dividers** or **programmable RF test**

systems and **switch matrices**; JFW dedicated customer service and engineering personnel can provide application specific components and sub-systems at catalog prices with an off-the-shelf attitude. For more information, please contact us or visit our web site at www.jfwindustries.com

JFW Industries, Inc.

Specialists in Attenuation and RF Switching

TEL (317) 887-1340 • Toll Free 1 (877) 887-4539 • Fax (317) 881-6790

5134 Commerce Square Dr. • Indianapolis, Indiana 46237

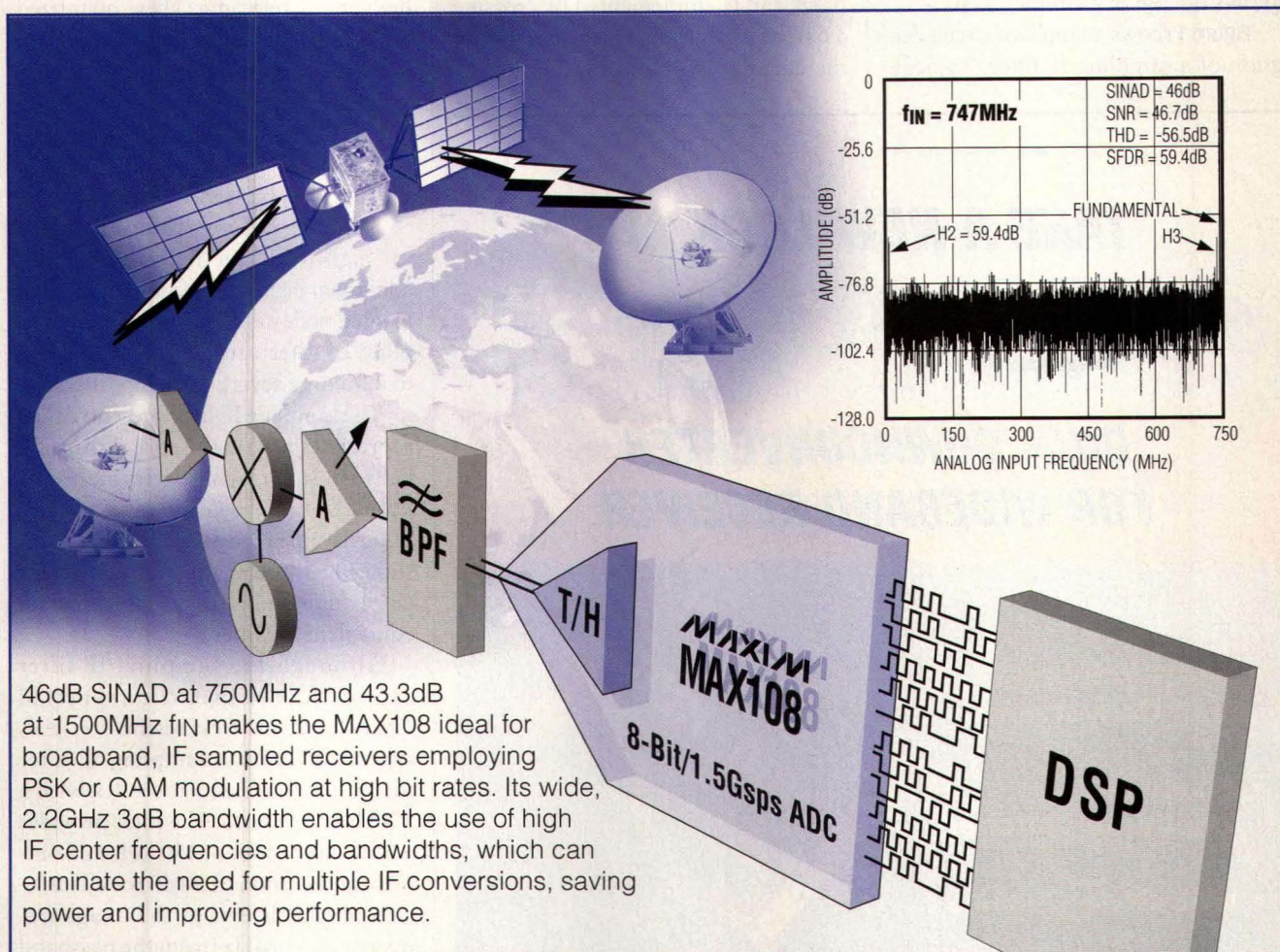
Internet— <http://www.jfwindustries.com>

E-mail— sales@jfwindustries.com

ISO 9001 Certified



RF/IF SAMPLING 1.5Gsp/s 8-BIT ADC HAS 46dB NYQUIST SINAD



- ◆ On-Chip 2.2GHz 3dB T/H Amplifier
- ◆ ± 0.25 LSB INL and DNL
- ◆ Selectable 8:16 Demux with Reset
- ◆ Pin-Compatible Upgrade for MAX104 and MAX106

MAXIM

www.maxim-ic.com

FREE A/D Converters Design Guide—Sent Within 24 Hours!

CALL TOLL-FREE 1-800-998-8800 (6:00 a.m.—6:00 p.m. PT)

For a Design Guide or Free Sample

**MAXIM/DALLAS
DIRECT!**
DISTRIBUTION
1-888-MAXIM-IC

ARROW
ARROW ELECTRONICS, INC.
1-800-777-2776

AVNET
CULICON
1-800-332-8638

Distributed by Maxim/Dallas Direct!, Arrow, Avnet Electronics Marketing, Digi-Key, and Newark.

MAXIM is a registered trademark of Maxim Integrated Products, Inc. © 2003 Maxim Integrated Products.

specified for an analog-to-digital converter (ADC) because the channel-selection filtering is performed before the sampler and ADC. This saves power and allows the use of a simpler ADC.

Figure 1 shows a simplified circuit diagram of a sampling IF filter. Typical-

ly, this approach employs differential circuitry, although the diagram of Fig. 1 shows a single-ended version for simplicity. In a differential circuit, the -1 block can be implemented by crossing a pair of wires to invert the polarity of the current. To build finite-impulse-

response (FIR) filters with an arbitrary sequence of tap coefficients whose values are 1, -1, or 0, the corresponding $P+$, $P-$, or $P0$, respectively, are set to be high at any one time. These quantized tap coefficients can be derived from an ideal FIR impulse response by delta-sigma (DS) quantization (ref. 4). Since the continuous-time input V_{in} is integrated continuously over the sample intervals, the filter has built in anti-aliasing.

Sampling IF filters can be designed for high RF image rejection without additional digital-correction techniques. In multimode radio applications, the sampling IF filter can be programmable, to eliminate several off-chip filters.

The sampling IF filter presented here represents a valuable breakthrough because superior in performance of both SC and gm-C filters. The sampling IF filter presented above consumes less power than an equivalent gm-C filter and is more stable than an equivalent SC filter.

Although the sampling IF filter approach can be applied to a variety of different systems, this presentation deals specifically with a sampling IF filter for an integrated Bluetooth Rx with a 13-MHz reference. The filter provides a 3-dB bandwidth of 480 kHz and out-of-band rejection of 50 dB for all undesired channels except the image frequency at -1 MHz (from the passband center frequency). For channels that are 3 MHz or more away from the desired channel, the filter provides at least 55-dB attenuation.

As an example, a filter was chosen with a 1-MHz sampling frequency with a 13-MHz option and a 2-MHz IF. The 13-MHz option allows initial 13-MHz sampling until the phase of the data clock is found and then switching to 1-MHz sampling to conserve power. Since the preamble of a Bluetooth packet is short compared to the length of a packet, the power savings for the filter and the downstream digital signal processor (DSP) can be substantial.

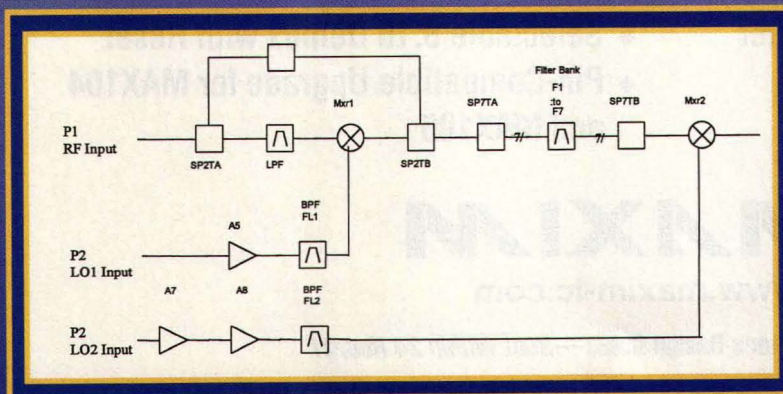
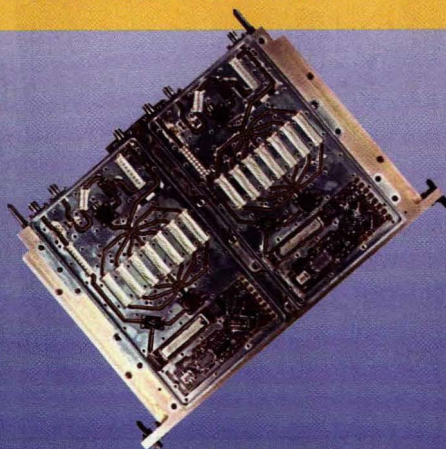
When designing a Bluetooth filter there is a trade-off between adjacent-channel interference (ACI) and ISI (see table). Generally, as the filter band-

TAKE A NEW LOOK AT



DUAL DOWNCONVERTER FOR WIDEBAND RECEIVER

- Ultra-Wideband, Dual Conversion
- Phase and Amplitude Matched
- VME Style Chassis



Herley Farmingdale, 425 Smith St., Farmingdale, NY 11735

TEL: 631-630-2000 • FAX: 631-630-2066

www.herley.com

E-Mail: sales@generalmicrowave.com

WORLD'S SMALLEST DIRECTIONAL COUPLERS

9 to 20dB... Immediate Delivery



\$1.99

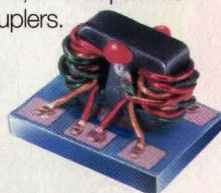
only each (qty. 25)

The DBTC series from Mini-Circuits is quite simply the smallest, **lowest priced** 5 to 2000MHz directional coupler series on Earth! Available in 9 to 20dB nominal coupling values, these patented 50Ω & 75Ω ohm couplers integrate Blue Cell™ design techniques for **very flat coupling**, low insertion loss, and multi-decade **broad bandwidths**. All-welded connections improve reliability, and automated production delivers high unit-to-unit performance repeatability. Plus, Mini-Circuits low price of only \$1.99 each (qty. 25) gets even lower with higher quantities! So, preserve precious board space, and capital as well. Specify Mini-Circuits DBTC directional couplers.

CUSTOM PRODUCT NEEDS...Let Our Experience Work For You.



Protected by U.S. Patent 6140887. Additional patents pending.



DBTC SPECIFICATIONS

Coupling	Model	Freq. (MHz)	Ins. Loss (dB) Midband Typ	Directivity (dB) Midband Typ
9dB	DBTC-9-4	5-1000	1.2	18
10dB	DBTC-10-4-75	5-1000	1.4	20
12dB	DBTC-12-4	5-1000	0.7	21
13dB	DBTC-13-4	5-1000	0.7	18
13dB	DBTC-13-5-75	5-1000	1.0	19
		1000-1500	1.4	17
16dB	DBTC-16-5-75	5-1000	1.0	21
		1000-1500	1.3	19
17dB	DBTC-17-5	50-1000	0.9	20
		1000-1500	1.0	20
		1500-2000	1.1	14
18dB	DBTC-18-4-75	5-1000	0.8	21
20dB	DBTC-20-4	20-1000	0.4	21

Dimensions 0.15" square.

DESIGNER'S KITS

K1-DBTC (50 Ohms) 5 of ea. DBTC-9-4, 12-4, 13-4, 17-5, 20-4. Total 25 Units \$49.95
K2-DBTC (75 Ohms) 5 of ea. DBTC-10-4-75, 13-5-75, 16-5-75, 18-4-75. Total 20 Units \$39.95

For detailed specs visit: www.minicircuits.com/dcoupler.html

We're redefining what VALUE is all about!

Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

ISO 9001 CERTIFIED

F 366 rev org.

width narrows, the ISI increases; as the filter bandwidth increases, so does the ACI. ISI is also dependent upon the group delay of the filter. Because a sampling IF filter is a finite-impulse-response (FIR) filter, the group delay is a constant value. Therefore, it is possible to design

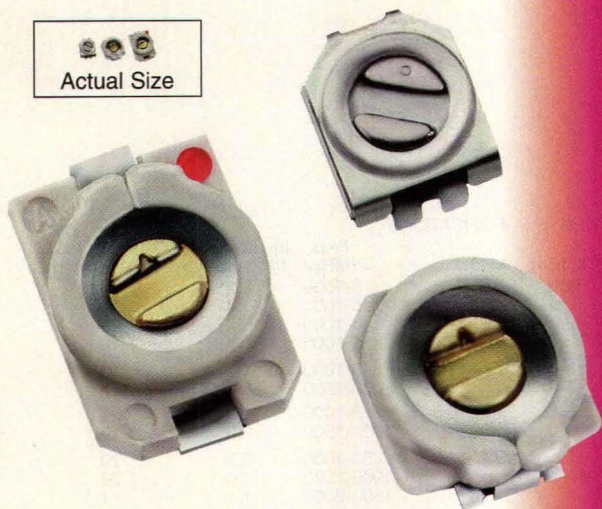
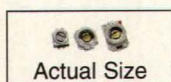
Interference specifications for a 2-MHz Bluetooth IF

ACI FREQUENCY (absolute)(MHz)	ACI FREQUENCY OFFSET FROM CARRIER (MHz)	ACI AMPLITUDE COMPARED TO DESIRED SIGNAL (dB)
-1	-3	20
0	-2	30
1	-1	0
3	1	0
4	2	30
5	3	40

CHIP TRIMMER CAPACITORS

Stability Better Than $\pm 1\%$

Delivery: Up to
50,000 pieces
stock to 4 weeks
on most parts!



Voltronics
INTERNATIONAL CORPORATION

The Trimmer Capacitor Company

100 Ford Road, Denville, NJ 07834
973.586.8585 • Fax: 973.586.3404
e-mail: info@voltronicscorp.com

www.VoltronicsCorp.com

a narrowband filter while maintaining low ISI. Referring again to Fig. 1, it is possible to design an ideal Bluetooth FIR filter with analog tap coefficients and then quantize these analog values to discrete digital values. These quantized digital values will then be applied to the P+, P-, or P0 inputs of the circuit.

The channel-selection filter has a sufficiently narrow bandwidth to serve as an anti-aliasing filter as well. Obtaining this level of stop-band rejection close to the passband would typically require a seventh-order or higher filter.

There are two distinct disadvantages in using high-order multipole filters. They are very sensitive to process and temperature variations, so that chip yields will be low and iterations may be necessary to center the design. The other disadvantage is that each stage must be very linear to prevent intermodulation distortion (IMD). Conventional approaches to achieve this linearity typically require high power consumption.

In Fig. 2, the red line represents the response of the filter with no process or temperature variations included. The blue lines represent the effects of component mismatch and all other circuit and temperature variations. The filter exhibits almost 2 MHz of bandwidth.

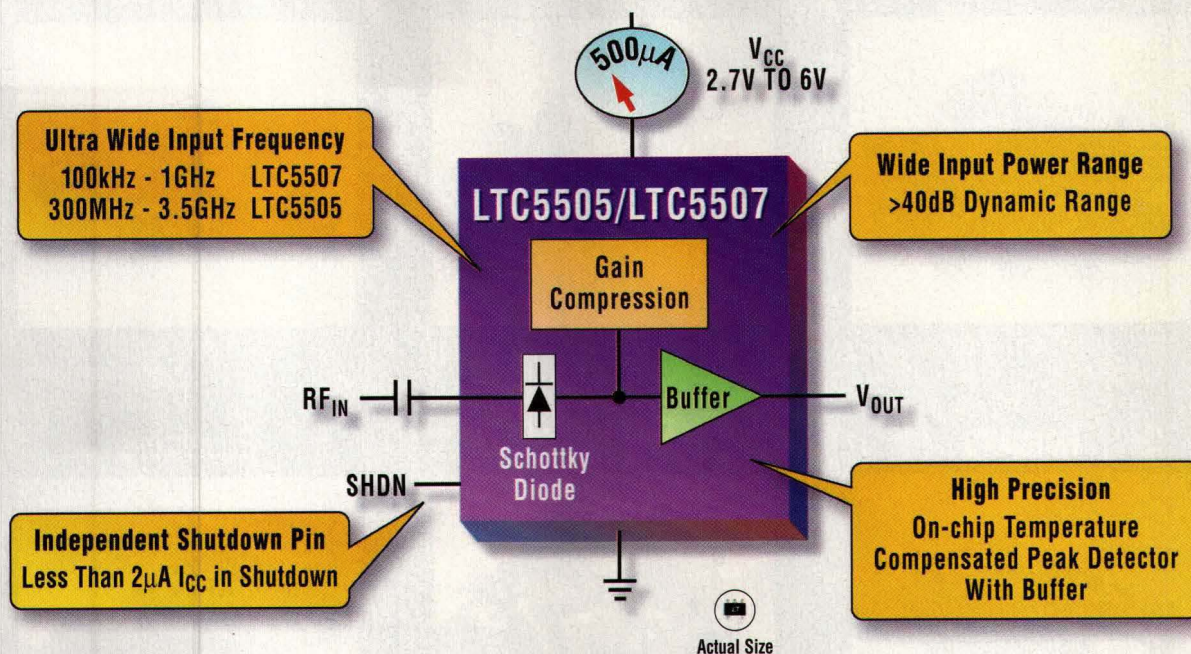
A sampling IF filter also has the benefit of 48 dB of AGC. The filter's gain is adjustable in 30-dB steps by means of a 4-b control word. **MRF**

REFERENCES

1. Mayank Garg and Sushant Suryagandhi, "A switched capacitor bandpass filter for a Bluetooth wireless receiver," University of Southern California at Los Angeles website, www.icsl.ucla.edu/~sushant/courses/EE215D/report.pdf.
2. Pietro Andreani and Sven Mattisson, "A CMOS gm-C polyphase filter with high image-band rejection," www.ess-circ.org/esscirc2000/proceedings/pdf/27.pdf.
3. Pietro Andreani and Sven Mattisson, "A CMOS gm-C IF filter for Bluetooth," www.tde.lth.se/home/piero/pdfArt/bp3MHz.pdf.
4. Sami Karvonen, Thomas Riley, and Juha Kostamovaara, "Charge sampling mixer with delta-sigma quantized impulse response," ISCAS 2002 IEEE International Symposium on Circuits and Systems, May 26-29, 2002, Session 1299.

RF Power Detectors

Low Power – Wide Range



RF In → Baseband Out With One or Two External Components

The LTC[®]5505 and LTC5507 are 100% production tested at frequency to minimize calibration and rework of the end device. The 1mm ThinSOT[™] package provides reliability, low thermal resistance, simple solder joint visual inspection and requires no special handling. With 500µA supply current and minimal number of external components, the easy-to-use LTC5505 and LTC5507 offer the industry's lowest power and smallest total solutions. Applications include: Mobile Phones, Wireless and Cable Infrastructure, Wireless Data Modems, ASK Demodulators, Optical Power Detectors, Envelope Detectors.

▼ Linear Technology's Growing Family of RF ICs

Low Supply Voltage Wireless Link: 1.8V to 5.25V Supply	
LT5502	400MHz Quadrature IF Demodulator with RSSI
LT5503	1.2GHz to 2.7GHz Direct IQ Modulator and Mixer
LT5500	1.8GHz to 2.5GHz RF Receiver Front End
Infrastructure and Handset	
LT5504	800MHz to 2.7GHz RF Measuring Receiver with 80dB Dynamic Range
LT5511	High Signal Level Upconverting Mixer with +17dBm Input IP3
LT5512	High Signal Level Downconverting Mixer with +17dBm Input IP3
LTC4400	RF Power Controllers with Autozero Loop for GSM/GPRS Cellular Phones
LTC4401	RF Power Controllers with Autozero Loop for GSM/GPRS Cellular Phones

▼ Data Sheets

www.linear.com/go/5505
www.linear.com/go/5507

▼ Online Store

www.linear.com/lineardirect

▼ More Information

Call: 1-800-4-LINEAR
 Visit: www.linear.com
 Info: 408-432-1900
 Fax: 408-434-0507

LTC and LT are registered trademarks and ThinSOT and SwitcherCAD are trademarks of Linear Technology Corporation, 1630 McCarthy Blvd., Milpitas, CA 95035



Become a Linear Insider
www.linear.com/insider



MIDWEST MICROWAVE

Attenuators



Fixed, Stepped, Continuously variable
Low VSWR, D.C. - 26.5 GHz, QPL

Terminations



Low to medium power, Open circuits
Short circuits, Low VSWR, D.C. - 26.5 GHz

D.C. Blocks



Inside/Outside, Inside Only
Rugged Construction

Couplers



Multi Couplers, Multi-Octave broadband
Hybrids, Octave bandwidth, D.C. - 18 GHz

Power Dividers



Broadband, Ultrabroadband, High Isolation
Low Phase & Amplitude Unbalance, D.C.-18 GHz

Equalizers



Broad or Narrow band, Fixed, Linear
Parabolic, Adjustable, D.C. - 18 GHz

Adapters



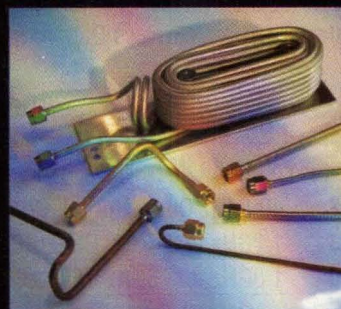
In - Series, Between Series, QPL
D.C. - 26.5 GHz

Cable Assemblies



Flexible, Phase Stable, Phase Matched
D.C. - 40 GHz

Delay Lines



Reformable, Phase Stable, Phase Matched
Delay Lines, D.C. - 40 GHz

For more information on any of these products and the rest of the Midwest Microwave range contact us:

United States and Canada

6564 South State Road, Saline Michigan 48176 Tel: 734 429 4773

Fax: 734 429 1415 E-mail: sales@midwest-microwave.com Web: www.midwest-microwave.com

International

Russell Way, Widford Industrial Estate, Chelmsford, Essex CM1 3AA United Kingdom Tel: 44 (0) 1245 359515

Fax: 44 (0) 1245 358938 E-mail: sales@midwest-microwave.ltd.uk Web: www.midwest-microwave.ltd.uk



Spectrum

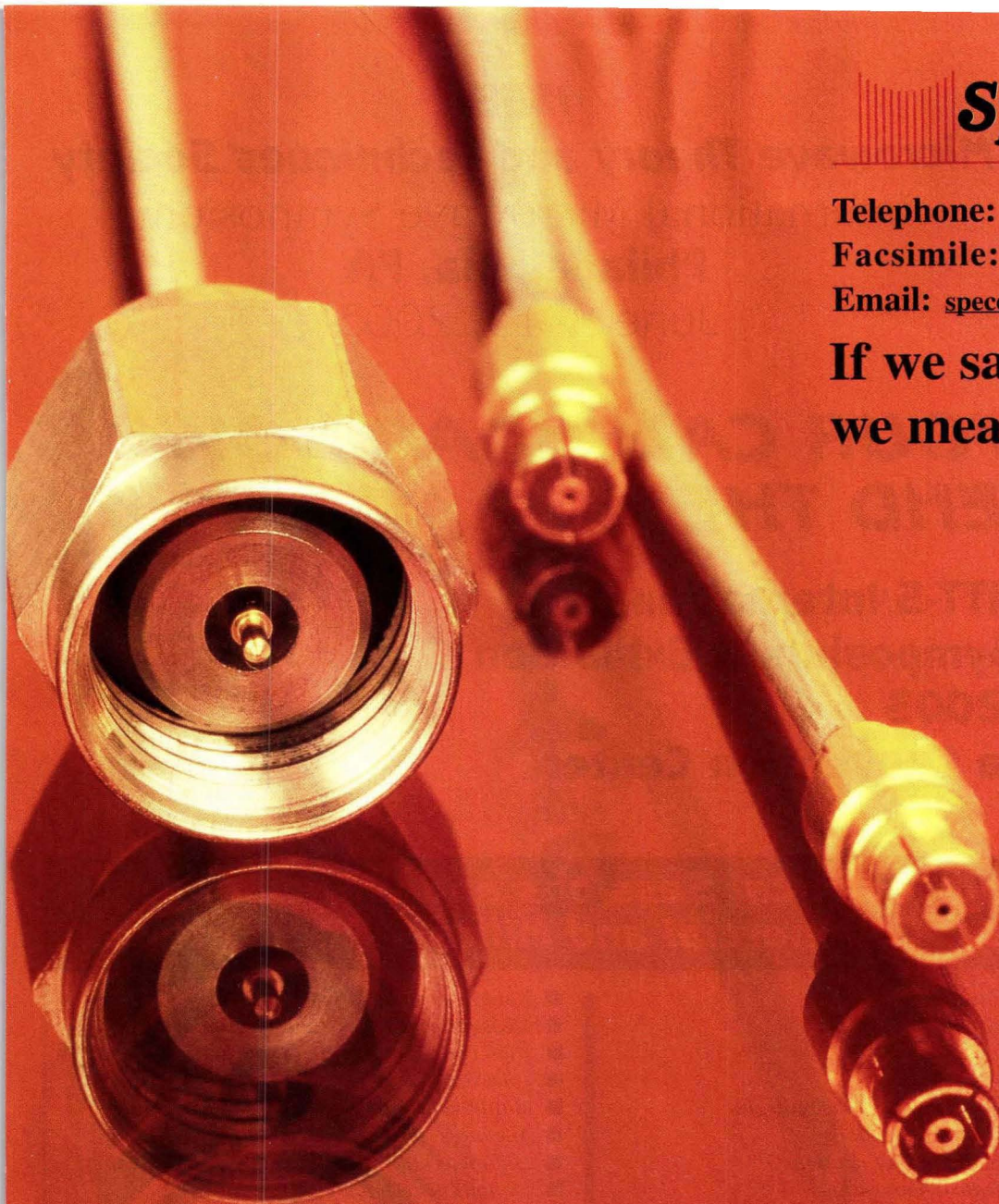
Elektrotechnik GmbH

Telephone: +49-89-3548-04-0

Facsimile: +49-89-3548-0490

Email: specelek@CompuServe.com

**If we say 65.0 GHz,
we mean it!**



Our 1.8 mm works superior to 65.0 GHz

Our SSPO works superior to 50.0 GHz*

Our 2.4 mm works superior to 50.0 GHz

Our 2.92 mm works superior to 40.0 GHz

Our 3.5 mm works superior to 26.5/35.0 GHz

We even have an SMA to 30.0 GHz!

Other series? We have them!

And: Only The Laws of Physics will stop us!

Building a superior product takes a big commitment. A commitment to employ motivated people, to use the best equipment, and to uphold the highest standard of quality in every project. Spectrum Elektrotechnik GmbH has built its reputation on this commitment. Quality is based on every employee, every procedure, every process. Quality is reflected in the creativity of our organization and in the satisfaction of our customers. Quality ensures that Spectrum Elektrotechnik GmbH will continue to offer the highest standards in microwave components. Spectrum Elektrotechnik GmbH has earned a reputation for quality. But this reputation requires constant attention. Through close communication with our customers and repeated analysis of our performance, we continually strive to strengthen our commitment. Commitment is our policy, quality is our product.

1.8 mm mates with V (Trademark of Anritsu/Wiltron)
SSPO mates with GPPO (Trademark of Gilbert Engineering)
2.92 mm mates with K (Trademark of Anritsu/Wiltron)

* At this time we have only adapters available SSPO to 2.4mm. Therefore we only can test our SSPO to 50.0 GHz. But we are confident that it will work to 65.0 GHz. We will proof it!

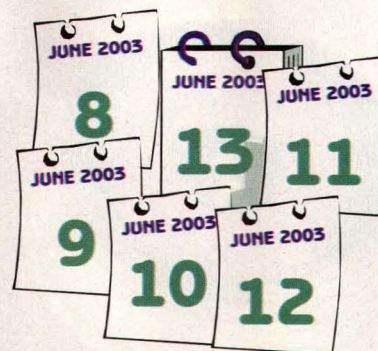
Please visit us @ www.spectrum-et.com



IEEE
Microwave Theory and Techniques Society
International Microwave Symposium
Philadelphia, PA
June 8–13, 2003

**MARK YOUR CALENDAR NOW
TO ATTEND THE**

**2003 IEEE MTT-S International
Microwave Symposium & Exhibition
June 8–13, 2003
Pennsylvania Convention Center**



**Featuring Technical Sessions and Workshops
for Wireless, Commercial and Military Applications**

- | | |
|--|--|
| <ul style="list-style-type: none">■ ICs for Wireless Communications■ Microwave Vehicular Technology■ CAD Design Methodology■ Power Devices and MMICs■ Wireless Communication Systems and Technologies■ Power Amplifiers for Wireless Applications■ Subsystems for Commercial Communications■ Biological Effects and Medical Applications■ Signal Generation, Frequency Conversion and Control Circuits■ Filters and Multiplexers■ Ferrite Components■ Guided Waves and Propagation Characteristics■ Transistor Power Amplification | <ul style="list-style-type: none">■ Nonlinear Modeling and Analysis■ Measurement Theory and Techniques■ High Power Sources and Control■ Low Noise Receivers■ Manufacturing, Production and Packaging■ Advances in Hybrid Technology■ Millimeter and Submillimeter Wave Technology■ Monolithic Technology■ Active and Quasi-optic Arrays■ Lightwave Technology and Techniques■ Superconductivity Technology■ Microwave Digital Processing■ Full Guest Program — Bring the Family! |
|--|--|

In addition to the outstanding Symposium, visit the World's Largest Microwave Exhibition, featuring more than 400 industry innovators displaying their newest wireless and commercial products and services. Once again this year, industry representatives will be presenting application and marketing seminars which will be open to all attendees.

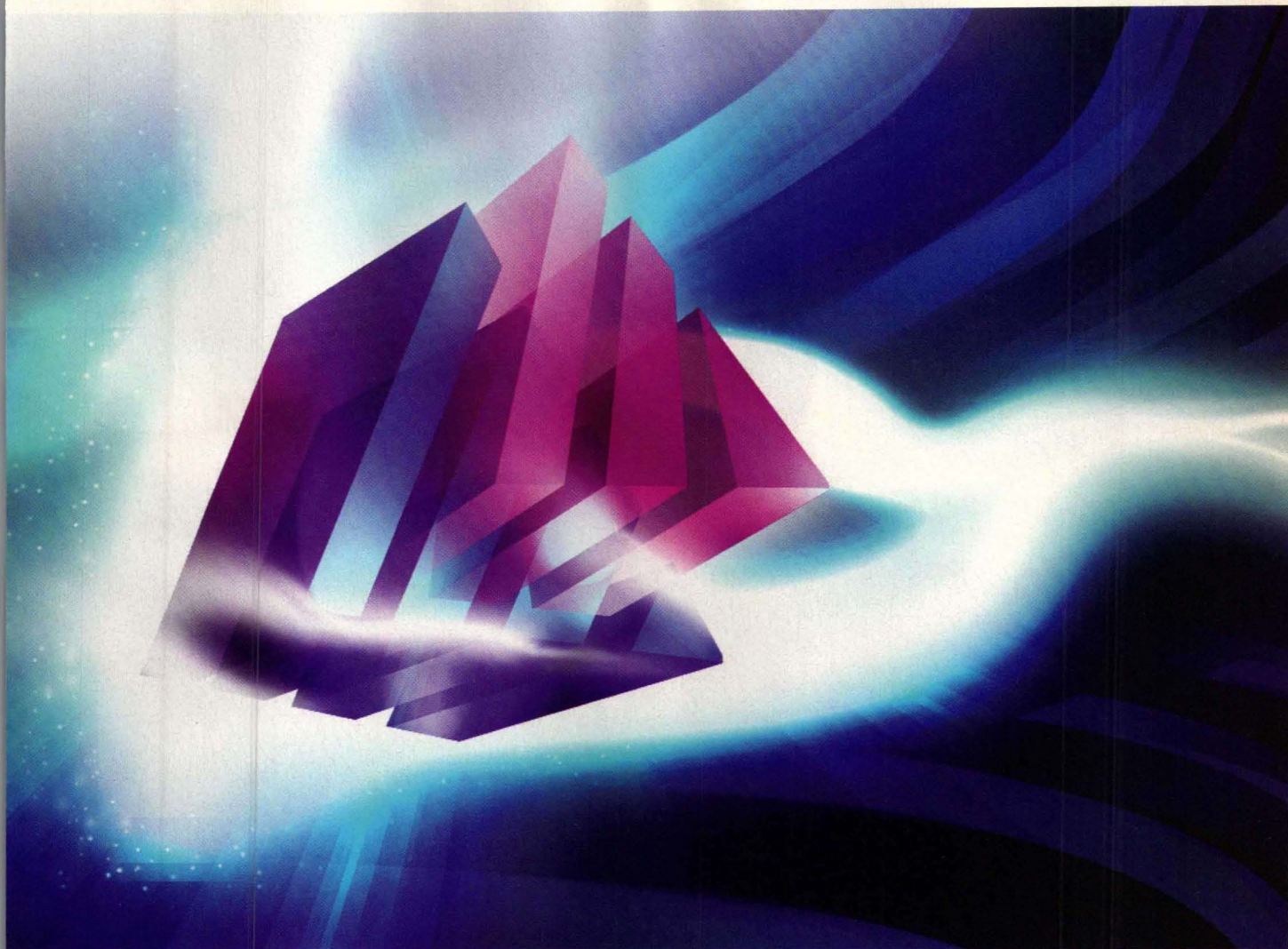
For information on attending the 2003 IEEE MTT-S International Microwave Symposium, please visit the official show website: www.ims2003.org. Or you may send your postal mailing address to *Microwave Journal* via e-mail, fax or postal mail.

Please contact us at:

e-mail: mwj@mwjournal.com
Fax: 781-769-5037
Post: *Microwave Journal*, 685 Canton St., Norwood, MA 02062

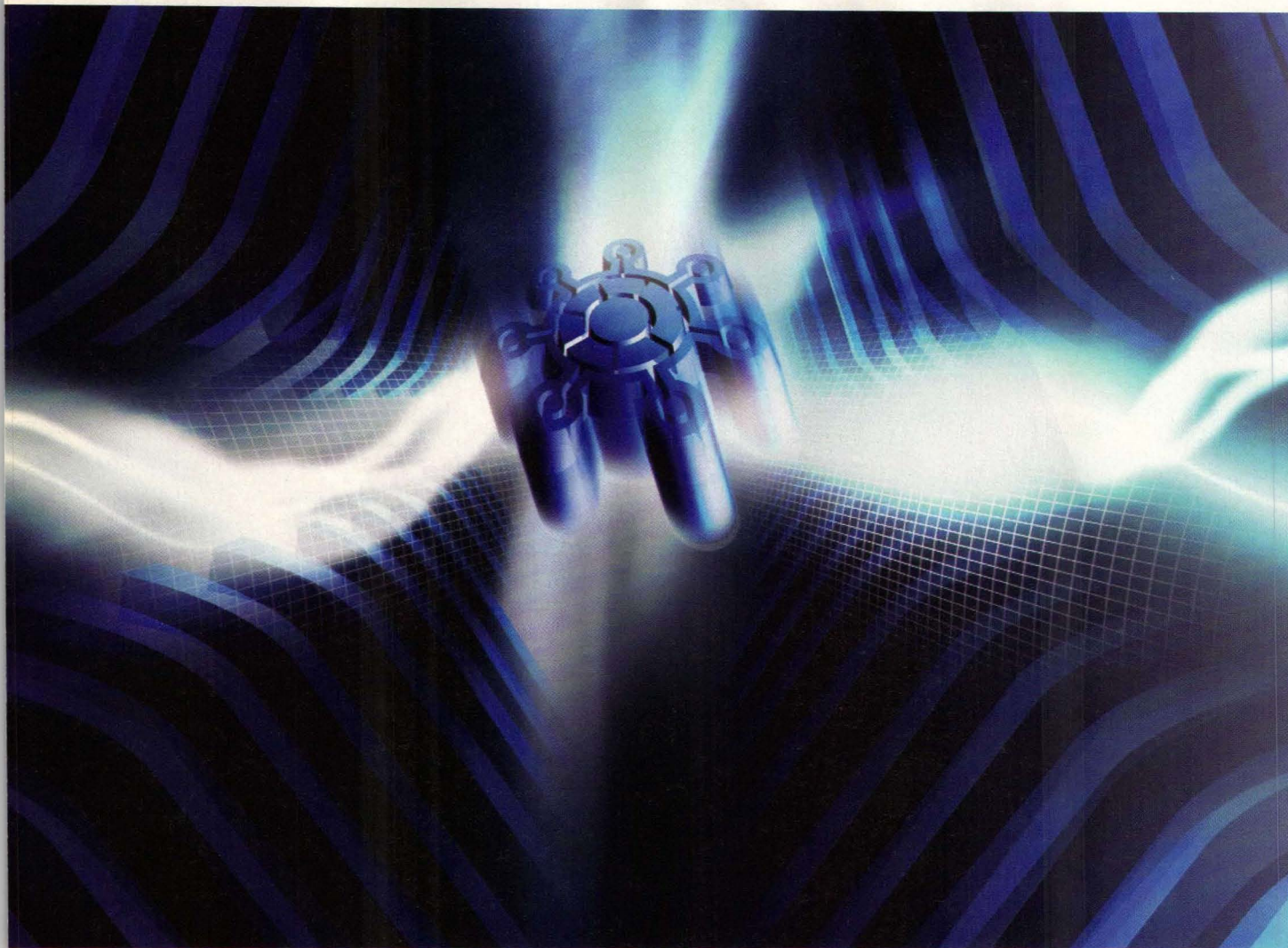
FULL PROGRAMS WILL BE MAILED IN MARCH

Access MTT-S On-Line at **Microwave Journal**® via <http://www.mwjjournal.com>.



From the company that brought you HFSS™...





...comes a new era of electromagnetically charged EDA software. Ansoft Designer's world-class circuit, system, and electromagnetic technology will redefine the way you design.



ANSOFT DESIGNER™

Electromagnetically Charged EDA Software

T108A

MODELING

Ansoft Designer integrates multiple electromagnetic solver technologies to provide the most complete physical design solution available. Ansoft Designer significantly improves accuracy while saving considerable time over traditional empirical characterization methods.

...ACCURATE...

SIMULATION

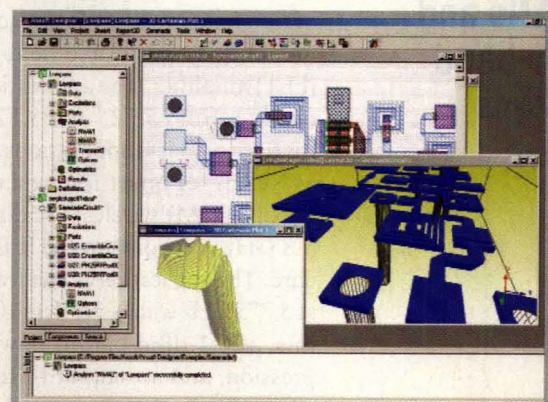
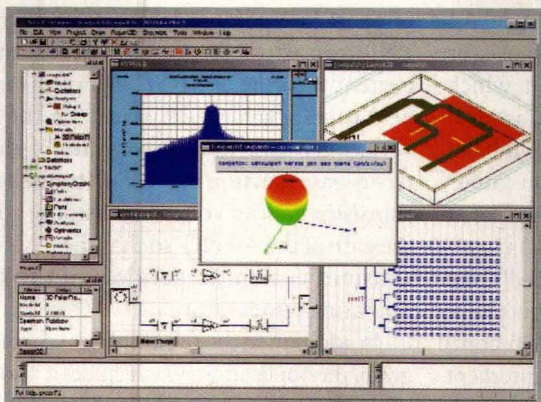
Ansoft Designer's time, frequency, and system analysis empower engineers to investigate all electrical performance criteria operating in real world conditions. True performance is understood and improved upon before committing to fabrication.

...FAST...

AUTOMATION

Ansoft Designer can address all communication, IC, and PCB applications with its fully integrated layout editor, supported Java® and Visual Basic® scripting, advanced library management, and third-party links.

...EFFICIENT...



To learn more, visit
www.ansoft.com/ansoftdesigner

Making the most of microwave prescalers

MICROWAVE PRESCALERS are often used in frequency synthesizers and millimeter-wave frequency-conversion applications. For engineers seeking information on a high-performance line of prescalers for operation through 13 GHz, an application note from Hittite Microwave Corp. (Chelmsford, MA), simply titled "Microwave Prescalers," explores how to connect power-supply, input and output lines, and other circuits to a microwave prescaler for optimum performance.

The line of microwave prescalers detailed in the application note is fabricated with InGaP GaAs heterojunction-bipolar-transistor (HBT) device technology for low phase noise at microwave frequencies. At frequencies as high as 13 GHz, the single-sideband (SSB) phase noise is -145 dBc/Hz offset 100 kHz from the carrier. The prescalers are designed to operate from a single +5-VDC supply, although the note cautions that the voltage supply should be well conditioned in order to minimize degradation of prescaler phase noise. In addition to a 15-pF capacitor that is integrated into the prescaler, the note recommends a pair of exter-

nal decoupling capacitors connected between the prescalers collected voltage terminal and ground, with capacitors placed as close to the collector voltage connection as possible.

Also to minimize noise, both of the prescaler's input lines should be DC blocked from the external circuitry. The capacitance and style of the DC blocking capacitors should be properly selected so that they do not cause significant attenuation of the input signal. The note provides guidance for both single-ended and differential input connections.

The note features useful advice on selecting optimal input and output signal levels, how to prevent prescaler self-oscillation, how to properly ground and heatsink a prescaler, and how to guard against degradation of phase-noise performance. In addition, the note includes an example 10.6-GHz phase-locked-loop (PLL) circuit for OC-192 fiber-optic communications applications. A free copy of the note can be downloaded from the company's website.

Hittite Microwave Corp., 12 Elizabeth Dr., Chelmsford, MA 01842; (978) 250-3343, FAX: (978) 250-3373, Internet: www.hittite.com.

The note features useful advice on selecting optimal input and output signal levels, how to prevent prescaler self-oscillation, and how to properly ground and heatsink a prescaler.

Circuit supports 5-GHz WLANs and UNII-band designs

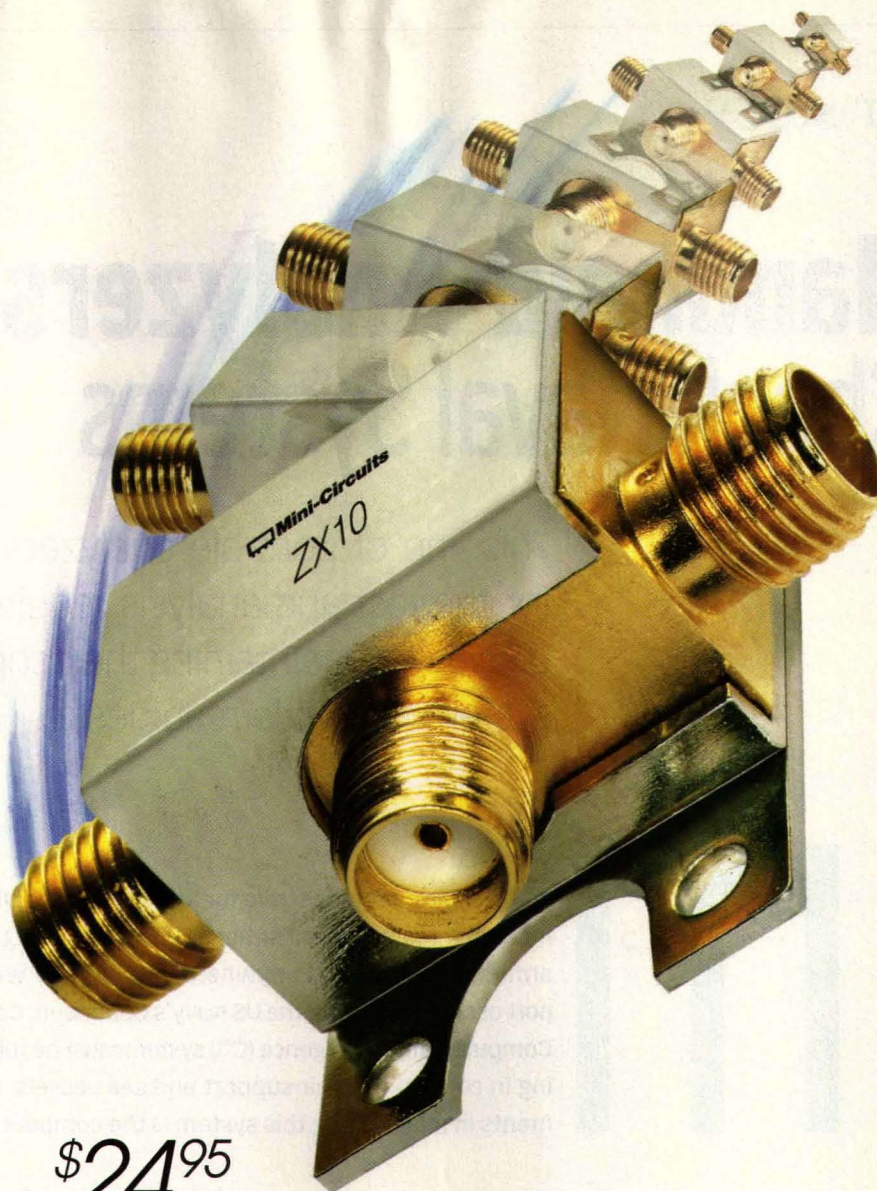
STABLE AMPLIFICATION at 5.8 GHz is the goal of an application circuit developed by WJ Communications (San Jose, CA) as a demonstration of the company's low-cost packaged model A4 monolithic microwave field-effect-transistor (FET) amplifier. The application circuit, which operates from 5.725 and 5.825 GHz, is ideal for fixed-wireless applications in the UNII band as well as for offset-frequency-division-multiplex (OFDM) wireless local-area networks at 5.8 GHz according to the IEEE 802.11a standard. The application circuit features 9.8-dB gain at 5.775 GHz with better than 10-dB output return loss, +28.1-dBm output power at 1-dB compression, and an output third-order intercept point of +42 dBm. By using the circuit in a balanced configuration, more than 1-W (+30 dBm) output power can be achieved.

The application note provides a full schematic diagram of the circuit, along with assembly details and test results for a finished version. The note recommends the use of an optional temperature-compensation active-bias circuit in

order to stabilize performance over wide temperature ranges. This circuit requires two standard voltage supplies of +8 and -5 VDC. The temperature-compensation circuit uses dual PNP transistors to provide a constant drain current into the A4 FET. Temperature compensation is achieved by tracking the voltage variations with the temperature of the emitter-to-base junction of the PNP transistors. The transistor emitter voltage adjusts the voltage at the gate of the A4 FET so that the device draws constant current, regardless of the device's operating temperature.

In addition to the full amplifier schematic diagram, the application note includes a photograph of the layout along with a schematic diagram of the temperature-compensation circuitry. A free copy of the note can be downloaded from the company's website.

WJ Communications, 401, River Oaks Pkwy., San Jose, CA 95134-1916; (408) 577-6200, FAX: (408) 577-6621, e-mail: sales@wj.com, Internet: www.wj.com.



\$24⁹⁵
from each

POWER SPLITTERS

2Way-0° 2MHz to 12.6GHz



SERIES A new breed of SMA power splitters are small in size, small in price, and big on features. They're ZX10 power splitters from Mini-Circuits! These splitters have extremely wide bandwidths so you can cover all of your applications with only a few units. Each easily mountable model is less than 3/4" in size, so you conserve real estate in laboratory, production, and system environments. And thanks to exclusive patent pending unibody construction, ZX10 splitters are rugged and phenomenally low in price. All models are **IN STOCK!** So contact Mini-Circuits now for individual units, or buy the 2MHz to 12.6GHz Designer's Kit for the lab, and never get caught short. Have the signal splitting power you need, on hand when you need it, with ZX10!

Mini-Circuits...we're redefining what VALUE is all about!

Typical Specifications

Model	Frequency (GHz)	Isolation (dB)	Insertion Loss (dB) Above 3.0dB	Price \$ea. (Qty. 1-24)
ZX10-2-12	.002-1.2	21	0.5	24.95
ZX10-2-20	.2-2	20	0.8	24.95
ZX10-2-25	1-2.5	20	1.2	26.95
ZX10-2-42	1.9-4.2	23	0.2	34.95
ZX10-2-71	2.95-7.1	23	0.25	34.95
ZX10-2-98	4.75-9.8	23	0.3	39.95
ZX10-2-126	7.4-12.6	23	0.3	39.95

Dimensions: 0.74"x0.50"x0.54"



K1-ZX10 Designer's Kit
1 of Each Model (7 total) \$199.95
FREE Deluxe Wood Storage Case!

Detailed Performance Data & Specs Online at: www.minicircuits.com/zx10-series.pdf

Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com


ISO 9001, ISO 14001 CERTIFIED

383 rev. orig.

cover story

Handheld Analyzers Check Naval Systems

This line of portable analyzers is well suited for the test and analysis requirements of the US Navy in maintaining their sophisticated C⁴I system for battle readiness.



Modern military forces strive for agility and mobility, given the nature of modern threats. Current strategies plan on putting rapidly deployed small armed on the ground anywhere in the world within 96 hours. In support of such readiness, the US Navy's Command, Control, Communication, Computer, and Intelligence (C⁴I) system must be fully functional and working in concert with air support and sea vessels. One of the key instruments in maintaining this system is the compact Site Master cable and

antenna analyzers and handheld spectrum analyzers from Anritsu Co., used by the Navy for service and performance diagnostics on their sophisticated C⁴I systems.

Although the Navy's measurement frequencies of interest are classified, the battery-powered Site Masters are designed with wideband measurement capabilities to cover a host of contingencies. Site Masters are currently offered with vector-network-analysis capabilities—with the ability to measure return loss and isolate faults in cable runs between a transmitter (Tx)/receiver (Rx) and an antenna—as well as with spectrum-analysis capabilities (in order to view traditional plots of signal amplitude as a function of frequency). For example, the recently announced S810C and S820C Microwave Site Masters are vector-analyzer-based instruments with frequency spans of 3.3 to 10.5 GHz and 3.3 to 20 GHz, respectively (**see figure**). Suitable for remote measurements of return loss and fault location, they feature a return-loss range of 0 to 54 dB with 0.01-dB resolution. These compact analyzers, which measure just 10 × 7 × 2.4 in. (25.4 × 17.78 × 60.96 cm) and weigh slightly more than 4 lbs. (1.8 kg), contain enough nonvolatile memory to store as many as 200 measurement traces.

In addition, model MS2711B is a portable spectrum analyzer with measurement range of 100 kHz to 3 GHz. It exhibits a noise level of better than -115 dBm and amplitude accuracy of ±2 dB. Weighing just under 5 lbs. (2.25 kg), the analyzer offers resolution-bandwidth filters of 10 kHz, 30 kHz, 100

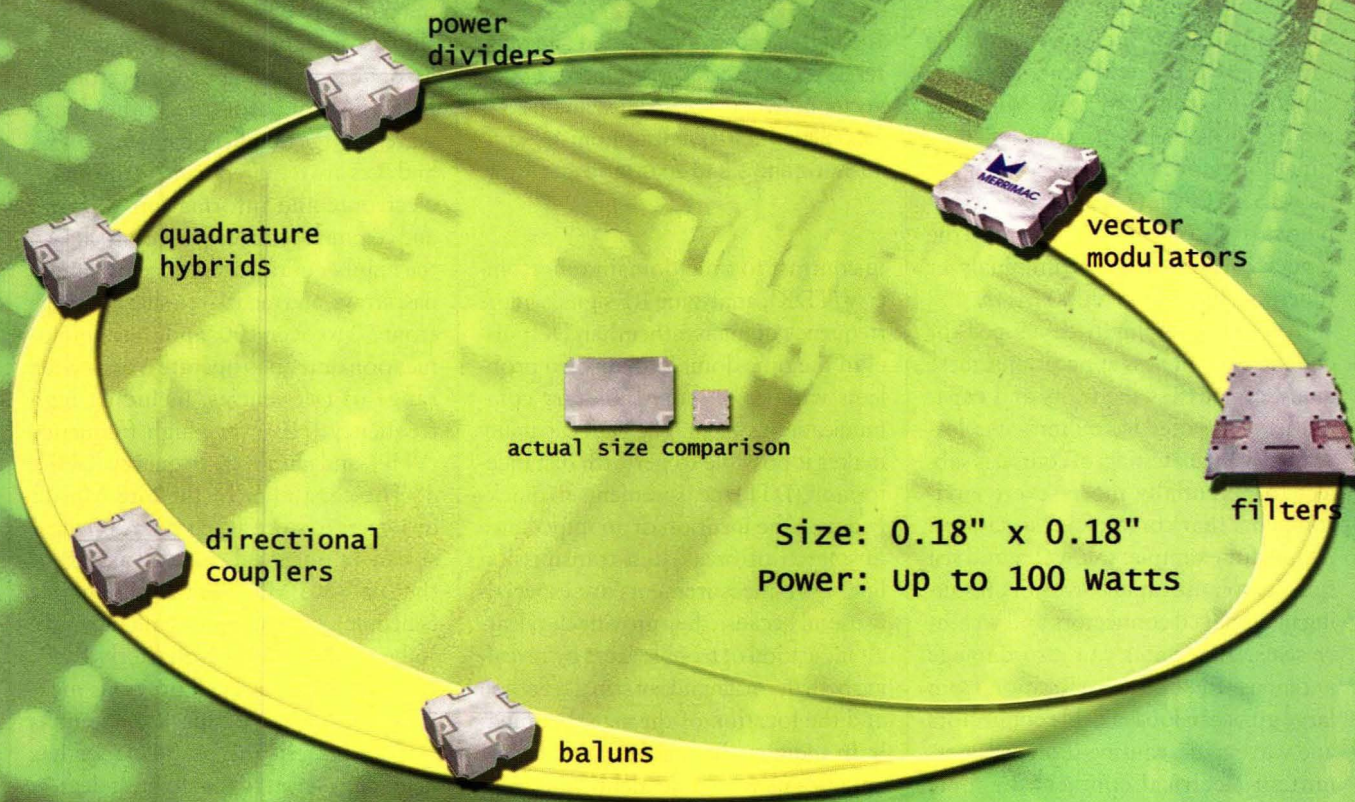
YUENIE LAU

Product Marketing Manager

Anritsu Co., 490 Jarvis Dr.,
Morgan Hill, CA 95037-2908;
(408) 778-2000, FAX: (408) 778-
0239, Internet:
www.us.anritsu.com.

Think about this...

Multi-Mix[®], "the PICO standard" for smart SIZE:POWER RF solutions

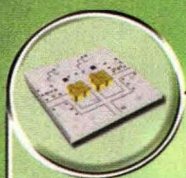


Multi-Mix[®] PICO Design Flexibility... Components to Integrated Modules



**Multi-Mix
PICO[™]
Components**

Miniaturized MW Components
Open Architecture
Flexibility
Surface Mount
For Your Integration



**Multi-Chip
Modules
(MCM)**

Pre-Mounted
Pre-Tested
Surface Mount
Connectorized
Prototype Toward Integration
"Known" Good Module



**Integrated
Modules**

High-Level Integration
Size Reduction
Better Power Handling/Reliability
Surface Mount
EMI/RFI Shielding
"Known" Good Module



**Micro-
Multifunction
Modules
(MMFM[®])**

Multilayer Integrated MMFM[®]
"Known" Good Module
Pre-Tested
Cost Effective



MERRIMAC
Total Integrated Packaging Solutions[®]

Tel: 1.888.434.6636
Fax: 973.882.5990
www.merrimacind.com

kHz, and 1 MHz and video-bandwidth filters from 100 Hz to 300 kHz. The instrument has built-in amplitude-modulation (AM) and frequency-modulation (FM) demodulation capabilities, trace averaging, an RS-232C interface, and is well suited for both Tx and Rx measurements. Other Site Masters include the model S113C, with scalar-analysis capabilities from 2 to 1600 MHz, the model S114C, with spectrum-analysis capabilities over the same range, the model S331C, with scalar-analysis capabilities from 25 to 4000 MHz, and the model S332C, with spectrum-analyzer functions from 25 to 4000 MHz.

Although nominally developed for commercial wireless applications, these analyzers possess the traits and capabilities well suited for military wireless testing. Military testing, of course, is subject to potentially more severe environments than commercial situations. At sea, for example, salt water and sea spray can cause rapid corrosion, resulting in damaged connectors and weather seals. Salt water can also damage antennas. In addition, vibration from large guns can loosen cable connectors and waveguide, causing shorts or intermittent electrical contacts. In some cases, servicemen may accidentally paint over an antenna or damage waveguide while painting, leading to electrical problems that can be readily detected with a SiteMaster instrument.

Communications and electronic-warfare (EW) systems on fighter planes extend from the cockpit to wingtips. The cabling is in a fixed, confined space that is often inaccessible. Furthermore, these aircraft systems are exposed to wide discrepancies in temperature. For example, temperatures on an aircraft carrier can reach as high as +120°F during takeoff and -62°F when a plane is at cruising altitude. Vibration caused by weapon firing is another factor that can adversely affect the performance of communications systems.

Despite these obstacles, communications systems must maintain operation for any mission to be a success. The Site Master analyzers feature frequency-domain reflectometry (FDR)



The portable, battery-powered Site Master S810C and S820C instruments offer vector-network-analysis measurement capabilities at frequencies from 3.3 to 10.5 GHz and 3.3 to 20 GHz, respectively.

in contrast to time-domain reflectometry (TDR), analyzing RF signals in the frequency domain rather than DC pulses in the time domain to discern problems with an on-board military communications system. The FDR capability makes it possible to perform distance-to-fault (DTF) measurements to quickly detect the location of an impedance mismatch or break in a transmission line. DTF measurements are especially useful because they provide the clearest indication of trouble areas by revealing both the magnitude of signal reflection and the location of the signal anomaly. In addition, the analyzers provide 517 data points to enable identification of faults at more than twice the range of competitive offerings.

This measurement capability serves as the foundation of all the Site Master analyzers, including those developed specifically for the military. Technicians are using Site Master analyzers to determine a cable and antenna system's health in just a few minutes. The analyzer can identify if there is water in the antenna, cable damage, a defective weather seal, or a loose connection. It can even determine if the antenna has been painted over or the waveguide has been damaged and its effect on signal transmission. All of these measurements can be made easily because the analyzer has an intuitive and menu-driven user interface that allows measurements to be made by servicemen who are literally in on-the-job training scenarios.

Another crucial benefit of the Site Master is the patented superior immunity to interference. The analyzers have

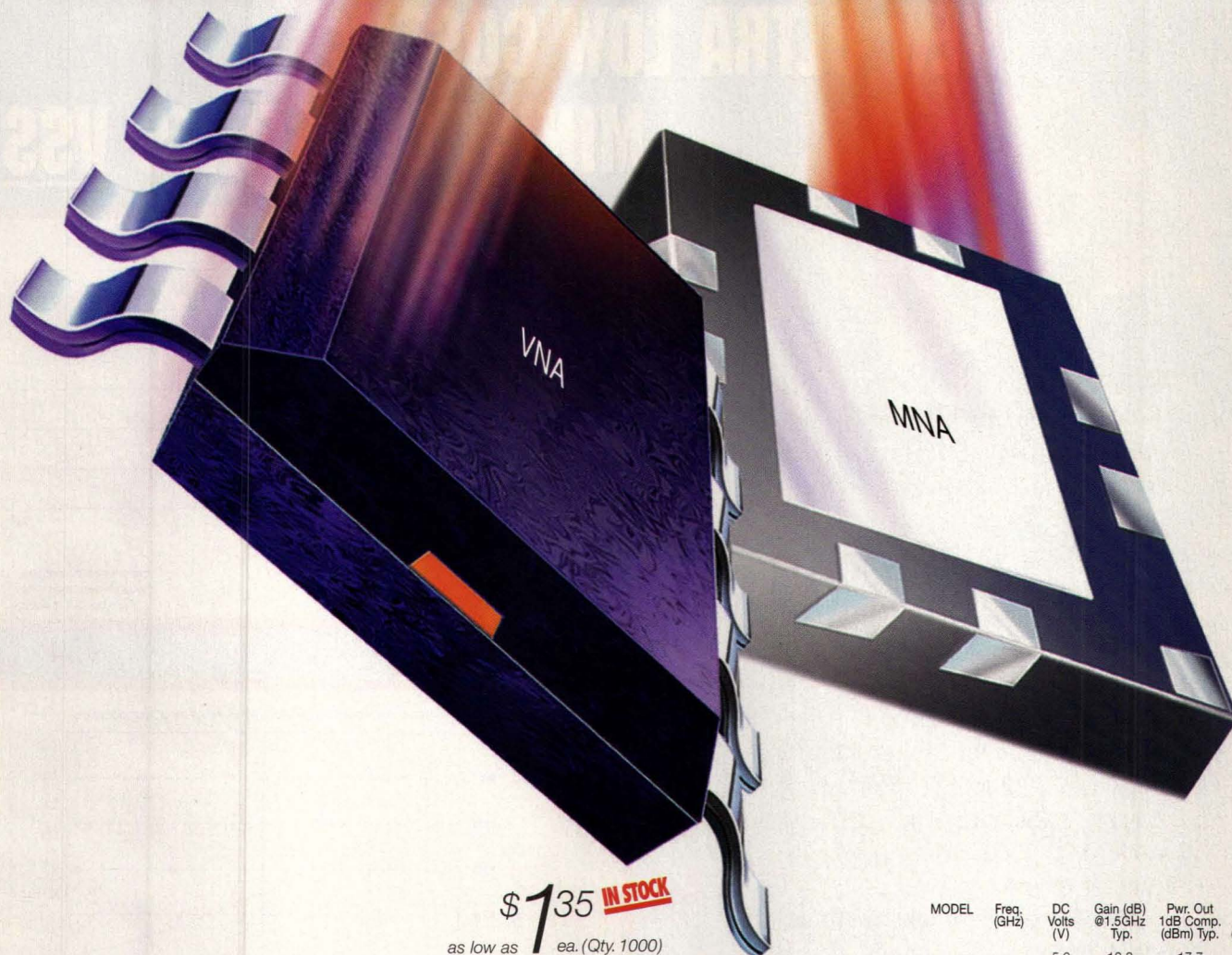
interference immunity of +17 dBm, which allows technicians to conduct analysis in the most complex and RF rich environments. This is especially important on a warship, which is part of a vast command, control, computer, and information network. Moreover, a Navy ship topside consists of a sophisticated assortment of weapons, electromagnetic (EM) radiators, and other hardware. A large number of antennas, Tx's, and Rx's are required to meet the radar, electronic and information warfare, and communication requirements. In fact, the number of radiating systems (antennas, arrays, and radar) on a ship can range from 50 to over 100, and the communication antennas operate over a wide range of frequencies, including high frequency (HF), very-high frequency (VHF), and ultra-high frequency (UHF).

The capability of the Site Master analyzers to store as many as 200 measurement traces is beneficial as part of the Navy's PMS (Plan Maintenance Schedule), which requires maintenance to be performed on a quarterly basis. A technician can recall previous measurements taken of specific antennas to determine if the performance has degraded—even to the slightest degree.

When testing aircraft EW systems, the Site Master gauges amplitude levels over a wide dynamic range, from insertion loss as low as -90 dB to gain as high as 50 dB (160-dB dynamic range) with 0.1-dB resolution. This analysis capability is used to ensure that new or replacement cables match the loss for loss sensitive application or phase in phase-sensitive application. It is also used to determine overall system loss.

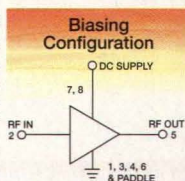
The lightweight, small size, and battery operation of the Site Master and handheld spectrum analyzers are also proving invaluable out at sea. When a technician is dangling 20 feet in the air at the tail section of a fighter plane or climbing a vertical ladder between decks on a ship, the fact that the instruments weigh about 5 lbs. (2.25 kg) proves invaluable. Anritsu Co., 490 Jarvis Dr., Morgan Hill, CA 95037-2908; (408) 778-2000, FAX: (408) 778-0239, Internet: www.us.anritsu.com.

500MHz-5.9GHz MMIC AMPLIFIERS



Built-In RF Choke, Resistors, Bypass & Coupling Capacitors

Simplify your 500MHz to 5.9GHz designs with Mini-Circuits easy to use MNA and VNA amplifiers. With DC blocking capacitors and a biasing network built-in, all you do is drop the amplifier in place on your PC board, connect, and the job is done! There's no biasing to figure out and no external components to connect. Broadband low and high power models offer gain from 9 to 23dB and power output from 7 to 19dBm. High isolation, typically greater than 40dB, makes them terrific for use as an isolator. And the versatility to operate from a



+2.8 to +5V DC supply makes them perfect for today's miniature battery operated hand-held devices. Two different package styles are available; MNA's leadless 3x3mm MCLPTM (Mini-Circuits Low Profile) SM package with exposed metal bottom for excellent grounding and heat dissipation, and VNA's leaded SOIC-8 for easier assembly...all value priced and ready to ship! So simplify your design, your manufacturing, *and your life* with Mini-Circuits all-in-one MNA and VNA MMIC amplifiers.

Mini-Circuits...we're redefining what VALUE is all about!

	MODEL	Freq. (GHz)	DC Volts (V)	Gain (dB) @1.5GHz Typ.	Pwr. Out 1dB Comp. (dBm) Typ.	Price \$ea. (qty.30)
ACTUAL SIZE	MNA-2	0.5-2.5	5.0 2.8	12.8 11.2	17.7 12.9	1.90
	MNA-3	0.5-2.5	5.0 2.8	16.1 15.0	11.4 9.7	1.60
	MNA-4	0.5-2.5	5.0 2.8	16.4 14.5	19.0 13.4	1.90
	MNA-5	0.5-2.5	5.0 2.8	21.9 20.5	12.2 10.1	1.60
	MNA-6	0.5-2.5	5.0 2.8	23.6 21.2	18.0 14.1	2.25
	MNA-7	1.5-5.9	5.0 2.8	15.9 13.7	15.6 12.7	2.25
	VNA-21	0.5-2.5	5.0 2.8	13.5 12.3	8.5 7.0	1.80
	VNA-22	0.5-2.5	5.0 2.8	13.8 12.6	17.0 14.0	2.20
	VNA-23	0.5-2.5	5.0 2.8	18.3 17.1	10.0 8.5	1.90
	VNA-25	0.5-2.5	5.0 2.8	18.6 17.4	18.2 12.0	2.50
	VNA-28	0.5-2.5	5.0 2.8	22.8 21.0	11.0 9.6	1.95

Detailed Performance Data & Specs Online at: www.minicircuits.com/amplifier.html

Amplifier Designer's Kits

K1-MNA: 10 of ea. MNA-2, 3, 5, 6...\$69.95

K2-MNA: 10 of ea. MNA-2, 3, 4, 5, 6, 7...\$99.95
Application note for PCB layout included.

Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



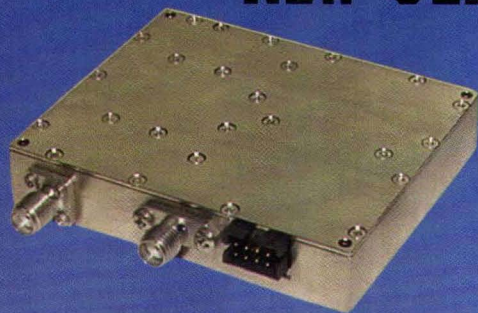
The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

ISO 9001 ISO 14001 CERTIFIED

389 Rev. Org.

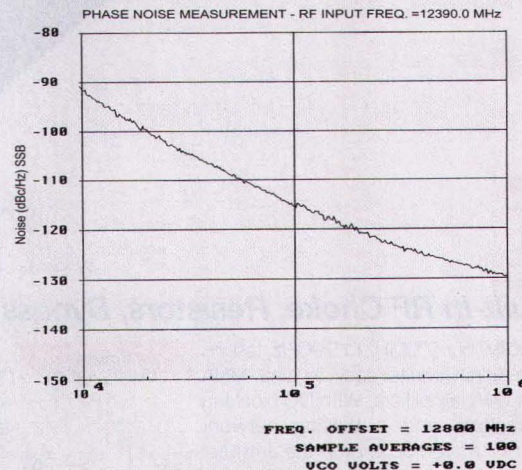
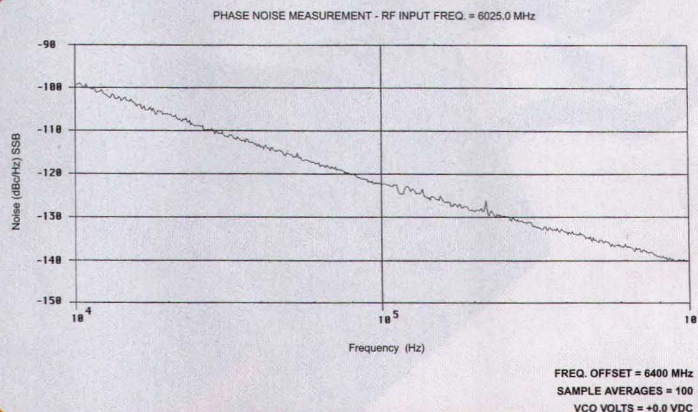
SYNTHESIZER SOLUTIONS

NEW ULTRA LOW COST MINIATURE SERIES VSS



The Series VSS are miniature microwave synthesizers designed for low cost, high data rate, digital radio, VSAT and SatCom applications. The Synthesizers are optimized for use in LMDS and digital radio systems where low cost and high flexibility are priorities. Its very small package is suitable for mounting in space-limited Up/Down Converter integrated assemblies.

- 500 MHz to 14 GHz (in Bands)
- Miniature Package for Drop-In Mounting
- Output Power +12 to +17 dBm
- DC Supply Voltage +5 Vdc at 275 mA typ;
80 mA for 500-2000 MHz
+15 Vdc at 40 mA typ.
- Operating Temperature (case) -10 to 70°C
standard; optional -30°C to +80°C
- Bandwidths 5-17%
- Low Power Consumption
- Very Low Phase Noise at high offsets
- Locks To 5 - 100 MHz External Reference
- High Phase Hit Immunity and Microphonics
- Synthesizes with optional Integrated IFLO
Meet SATCOM IESS 308/309 specification
@ CBand



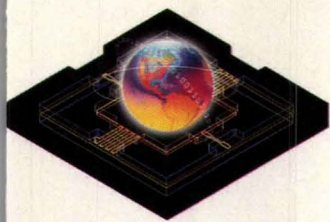
GET THE PERFORMANCE YOU NEED AT THE PRICE YOU WANT

CALL THE EXPERTS!



9 Whippany Rd. • Whippany, NJ 07981
TEL: 973-884-2580 • FAX: 973-887-6245
www.cti-inc.com • e-mail: sales@cti-inc.com





STRATEDGE

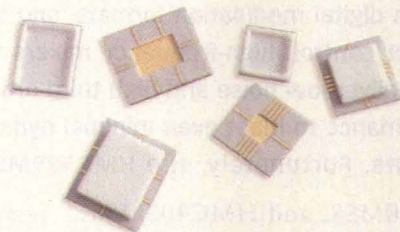
THE BEST ELECTRICAL PERFORMANCE IN MICROWAVE PACKAGES

HI-SPEED
WIRELESS
DEVICES

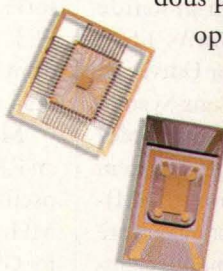
You've designed the perfect microwave circuit for high performance and reliability, now you need the package to keep it perfect. One company has been designing, building and delivering microwave package solutions longer than anyone: StratEdge. The result is millions of packages delivered to commercial and Hi-Rel customers just like you.

- ISO 9002 Certified
- Volume Production Since 1992
- Innovative, Patented Technology
- Complete Simulation and Design Capability
- Test and Assembly Services
- Microwave and mmWave Packages
- Production Packages from DC thru 50 GHz
- Single Chip MMIC Power Amp Packages
- High Speed Digital Packages
- MCM Packages
- Commercial & Hermetic Packages
- Leadless, Leaded & SMT Designs
- Glass and Ceramic Dielectrics

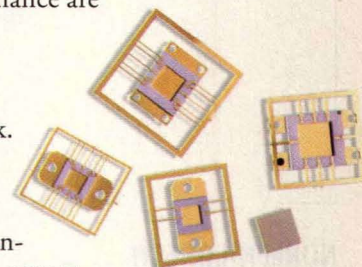
4393 Viewridge Avenue
San Diego, California
92123
858-569-5000 Ext.202
www.stratedge.com/mwrf



SE50 Series - Offering the widest operational bandwidth available today; DC through 50 GHz! Perfect for Point-to-Point, Point-to-Multipoint radio, LMDS, and any other application where price and performance are paramount.

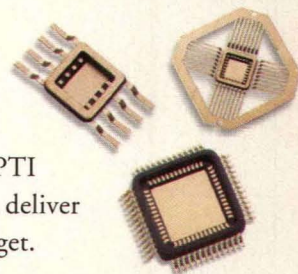


LCC Series - The VSAT industry benchmark. Operational from DC to 23 GHz, the LCC offers leads for easy next level interconnect, with the ability to handle tremendous power. The LCC has found success in VSAT, optical and instrumentation systems.



OC-768 Packages - If you're tasked with the challenge of packaging OC-768 devices, only StratEdge engineers have the experience and technology required for designing broad bandwidth High Speed Digital packages through 50 GHz.

OC-192 Packages - StratEdge was the first to develop High Speed Digital, OC-192 packages. Whether you choose a ceramic wall, or glass side wall package from the PTI Division of StratEdge, our microwave design engineers can deliver a leaded or surface mount solution that will meet any budget.



STRATEDGE

MMIC Mixers Reach High Intercept Points

These high-dynamic-range monolithic mixers set new standards in third-order-intercept-point performance for cellular and PCS infrastructure applications.

dynamic range is a key requirement for the latest cellular and personal-communications-services (PCS) base stations. With growing complexity in digital modulation formats, and the use of dynamic power control, high-frequency mixers for these systems must deliver low noise and high third-order-intercept-point performance to meet even minimal dynamic-range requirements. Fortunately, the HMC399MS8,

HMC400MS8, and HMC402MS8 monolithic-microwave-integrated-circuit (MMIC) mixers from Hittite Microwave (Chelmsford, MA) achieve third-order-intercept points (IP3s) to +36 dBm at cellular and PCS frequencies.

These passive gallium-arsenide field-effect-transistor (GaAs FET) MMIC mixers are ideal for Universal Mobile Telecommunications System (UMTS)-, code-division-multiple-access (CDMA)-, and Global System for Mobile Communications (GSM)-based systems. The low-cost mixers are supplied in plastic surface-mount eight-lead mini-small-outline-package

(MSOP) housings and will satisfy a wide range of RF and intermediate-frequency (IF) plans for frequency upconversion or downconversion. At just 15 mm², the footprint of these new MSOP mixers is one-tenth the size of a typical hybrid mixer J-lead package footprint of 152 mm². The high input IP3 performance and output power at 1-dB compression rivals performance of traditional hybrid active FET mixers for an equivalent +17-dBm LO drive while requiring no DC bias supply.

Model HMC399MS8 operates over an RF range of 740 to 960 MHz, local-oscillator (LO) range of 540 to 900 MHz, and IF range of 60 to 250 MHz for GSM and CDMA applications. It provides IP3 performance to +35 dBm for

downconversion and +32 dBm for upconversion. The mixer achieves as much as +23 dBm at 1-dB compression with 8.5-dB typical conversion loss and as much as 23 dB LO-to-

NORM HILDRETH

Director of Product Development

Hittite Microwave Corp., 12 Elizabeth Dr., Chelmsford, MA 01842; (978) 250-3343, FAX: (978) 250-3373, Internet: www.hittite.com

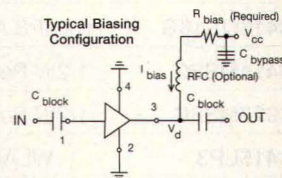
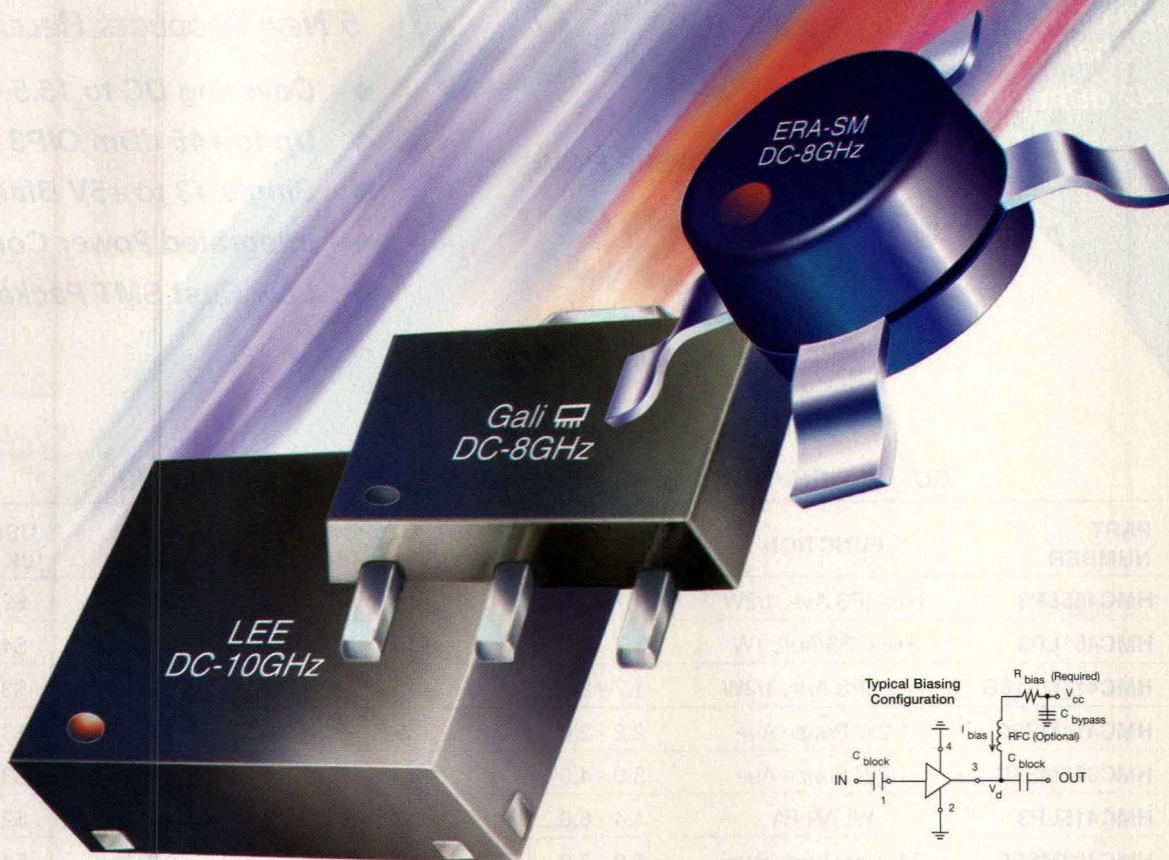
The high-IP3 mixers at a glance.

PARAMETER	HMC399MS8	HMC400MS8	HMC402MS8
RF range (GHz)	0.74 to 0.96	1.7 to 2.2	1.8 to 2.2
LO range (GHz)	0.54 to 0.9	1.4 to 2.15	1.85 to 2.53
IF range (MHz)	60 to 250	50 to 300	50 to 500
LO-to-RF isolation (dB)	25	33	30
Input IP3 (dBm)	+35	+36	+31

IN STOCK

MMIC AMPLIFIERS

DC-10GHz as low as **99¢** ea. (qty. 30)



GAIN FROM 8 up to 23dB, OUTPUT POWER up to +20dBm

If you need to find a MMIC amplifier with just the right performance and size to fit your design, your job just got easier! Introducing Mini-Circuits LEE, Gali, and ERA-SM families. Now you can select from a variety of over 40 broadband InGaP HBT and low noise silicon based models with flat gain from 8 up to 23dB, low to high output power of +2.8 to +20dBm, and very high IP3 up to 36dBm typical. These affordable, rugged, compact amplifiers have low thermal resistance for high reliability, and come in three different



package styles to suit your design layout requirements; the leadless 3x3mm "Mini-Circuits Low Profile" (MCLP™) package with exposed metal bottom for superior grounding and heat dissipation, plus the SOT-89 and Plastic Micro-X with leads for easier assembly. You'll find all the performance specs and data on our web site, plus a wide selection of amplifier Designer's Kits with free test fixture included! So broaden your MMIC amplifier choices and maximize performance with Mini-Circuits LEE, Gali, and ERA-SM.

Mini-Circuits...we're redefining what VALUE is all about!

Detailed Performance Data & Specs Online at: www.minicircuits.com/amplifier.html



Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

ISO 9001 ISO 14001 CERTIFIED

376 Rev. A

LINEAR AMPLIFIERS

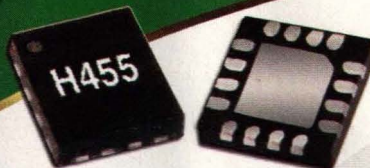
FOR CELLULAR, BROADBAND & MICROWAVE SYSTEMS

HMC455LP3 1/2 WATT AMP

13 dB Gain

+20 dBm CDMA2000
Channel Power*

+42 dBm OIP3



LINEAR DRIVERS FROM

\$2.95
@ 10K PCS

5 NEW PRODUCTS RELEASED!

- ◆ Covering DC to 15.5 GHz
- ◆ Up to +45 dBm OIP3
- ◆ Single +3 to +5V Bias
- ◆ Integrated Power Control
- ◆ Low Cost SMT Packages

DC - 15.5 GHz SMT LINEAR AMPLIFIERS, LOW COST & IN-STOCK!

	PART NUMBER	FUNCTION	FREQUENCY RANGE (GHz)	OUTPUT IP3 (dBm)	GAIN (dBm)	P1dB (dBm)	USD @ 10K PCS
NEW!	HMC455LP3	HIGH IP3 AMP, 1/2W	1.7 - 2.5	+42	13	+27	\$2.95
NEW!	HMC461LP3	HIGH IP3 AMP, 1W	1.7 - 2.2	+45	12	+30	\$4.92
	HMC413QS16G	HIGH IP3 AMP, 1/2W	1.7 - 2.3	+40	22	+27	\$3.71
	HMC414MS8G	1/2W POWER AMP	2.2 - 2.8	+39	20	+27	\$3.70
	HMC327MS8G	1/2W POWER AMP	3.0 - 4.0	+40	21	+27	\$3.25
	HMC415LP3	WLAN PA	4.4 - 6.0	+32	20	+23	\$2.65
	HMC407MS8G	MEDIUM POWER AMP	5.0 - 7.0	+40	15	+25	\$4.64
	HMC408LP3	1W POWER AMP	5.1 - 5.9	+43	20	+30	\$4.91
NEW!	HMC441LP3	MEDIUM POWER AMP	6.5 - 13.5	+29	14	+18	\$9.25
NEW!	HMC441LM1	MEDIUM POWER AMP	7.0 - 15.5	+30	16	+19	CALL
NEW!	HMC311LP3	HBT GAIN BLOCK	DC - 6.0	+30	14.5	+15	\$1.40

SELECT PRODUCTS AVAILABLE IN DIE FORM. ALL DATA IS MID-BAND TYPICAL.

*1.96 GHz CDMA2000, 9 CHANNELS FORWARD, -45 dBc ACPR

ACTUAL SIZE

MS8G
14.6mm²



QS16G
29.4mm²



LP3
(QFN)
9mm²



LM1
25.8mm²



Corporate Headquarters

12 Elizabeth Drive, Chelmsford, MA 01824
Ph (978) 250-3343 Fax (978) 250-3373 sales@hittite.com

World Wide Offices

HMC Europe, Ltd. Ph +44(0) 1256-817000 Fax +44(0) 1256-817111 europe@hittite.com
HMC Deutschland GmbH Ph +49 8031-97654 Fax +49 8031-98883 germany@hittite.com
HMC Asia Co., Ltd. Ph +82-2 559-0638 Fax +82-2 559-0639 asia@hittite.com

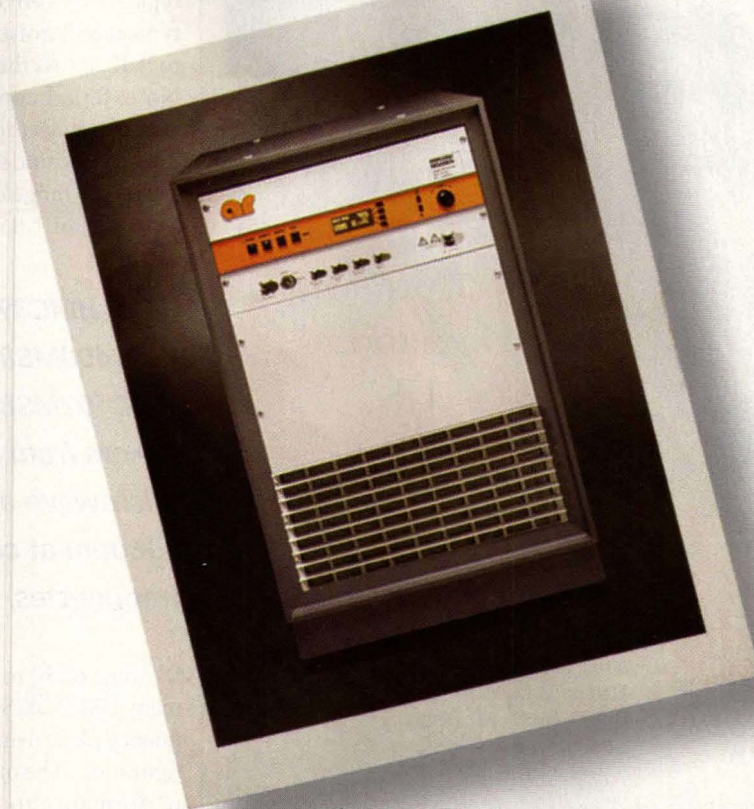
ORDER ON-LINE:
www.hittite.com



ISO 9001
Certified

Distributed in the Americas by Future Electronics Ph (800) Future-1, ext. 2754 www.futureelectronics.com/rf

Kicking The Competition's Tail For 200 Watt Testing.



The 200S1G4

The world's only 200-watt, 0.8 to 4.2 GHz, all-solid-state amplifier. Exceptional linearity. Unequaled harmonic performance. 100% mismatch tolerant. Unbeatable technology and design. An advanced instrument for 200-watt testing, this is the amplifier of choice for EMC and linear wireless applications, with digital front panel displays and AR's famous three-year warranty.

To us, AR Quality must = Value and AR Value is multi-dimensional. With innovation in technology, advanced design, durability and longevity, mismatch capability, a limitless support network and less cost watt for watt. Plus, the best warranty in the business. Look for the 200S1G4 and our new 240-watt, 0.8 to 3.0 GHz 240S1G3 at www.amplifiers.com/microwave.asp.

ISO 9001
Certified

Copyright© 2003 Amplifier Research. The orange stripe on AR products is Reg. U.S. Pat. & Tm. Off.



Quality = Value™

USA 215-723-8181 or 800-933-8181 for an applications engineer.
In Europe, call EMV - Munich: 89-614-1710 • London: 01908-566556 • Paris: 1-64-61-63-29 • Amsterdam: 31-172-423-003

RF isolation and 27 dB typical LO-to-IF isolation (see table). The single-sideband (SSB) noise figure is typically 9 dB over an RF range of 740 to 800 MHz, typically 8.5 dB for an RF range of 800 to 900 MHz, and typically 8 dB for an RF range of 880 to 960 MHz. The

mixer requires only an external inductor and capacitor to optimize the LO frequency response.

Model HMC400MS8 covers an RF range of 1.7 to 2.2 GHz, LO range of 1.4 to 2.15 GHz, and IF range 50 to 300 MHz; it is suitable for most UMTS/PCS

transmit or receive frequency plans configured with low-side LO architectures. This mixer offers excellent input IP3 performance to +36 dBm for downconversion to +31 dBm for upconversion. Rated for 1-dB compression of +21 dBm, the RF port can handle a wide range of input signal levels. The typical conversion loss is 8.8 dB while the typical LO-to-RF isolation is 33 dB and the typical LO-to-IF isolation is 23 dB. The typical SSB noise figure ranges from 8 to 9 dB across the full frequency range. No external components or bias are required with the HMC400MS8.

Finally, model HMC402MS8 covers an RF range of 1.8 to 2.2 GHz, an LO range of 1.85 to 2.53 GHz, and an

IN FOCUS

Harbour Industries Can Put Your High Performance Coax Demands "IN FOCUS"

Harbour Industries' MIL-C-17 Coax

High performance, high temperature QPL approved MIL-C-17 coaxial cables are manufactured for many different RF Microwave markets. All of Harbour's "M17" cables are manufactured in accordance with the most recent MIL-C-17 revisions to ensure a quality product. Harbour's "M17" coax cables exceed mil-spec attenuation and VSWR requirements, and Harbour's "M17" cables should be chosen for the most demanding RF systems.

Harbour Industries' SPECIALTY AEROSPACE Coax

Custom engineered high performance coaxial cables provide solutions for low attenuation, high frequency, and high power applications. High strength and lightweight designs satisfy the most demanding aerospace requirements.

Harbour Industries HPF High Performance Foam Dielectric, Flexible Coax

HPF flexible coaxial cables will curve, twist, and snake their way into those hard to reach spots that more rigid cables just can't touch. VSWR and attenuation levels exceed industry standards for Wireless and Cellular Communications, Personal Communications Systems, and Antenna Systems.

Harbour Industries SC SUREFORM® Coax

Sureform coaxial cables manufactured by Harbour Industries are easy forming, shape holding alternatives to semi-rigid cables. Sureform cables may also replace flexible "M17" or "RG" cables when a higher level of shielding is required. Harbour's proprietary "soldered braid" yields low attenuation and the highest possible shielding effectiveness of any flexible coaxial cable.

**The HMC399MS8,
HMC400MS8, and
HMC402MS8 MMIC
mixers from Hittite**

**Microwave achieve IP3s to
+36dBm at cellular and PCS
frequencies.**

IF range of 50 to 500 MHz, satisfying many UMTS/PCS transmit or receive frequency plans using a high-side LO configuration. The mixer features solid IP3 performance to +31 dBm for downconversion and to +27 dBm for upconversion. The 1-dB compression point is +21 dBm and the typical conversion loss is 8.5 dB. The typical SSB noise figure ranges from 8.5 to 8.8 dB across the full 1800-to-2200-MHz RF range. The HMC402MS8 exhibits 30 dB typical LO-to-RF isolation and 24 dB typical LO-to-IF isolation. As with the lower-frequency mixers, the HMC402MS8 does not require external components or a bias supply. All three mixers are 100-percent RF tested; all three are designed for nominal LO drive levels of +16 to +18 dBm. P&A: stock. Hittite Microwave Corp., 12 Elizabeth Dr., Chelmsford, MA 01842; (978) 250-3343, FAX: (978) 250-3373, Internet: www.hittite.com.

4744 Shelburne Road
P.O. Box 188
Shelburne, Vermont 05482
802-985-3311
www.harbourind.com



Harbour
INDUSTRIES

Easy as ABS!

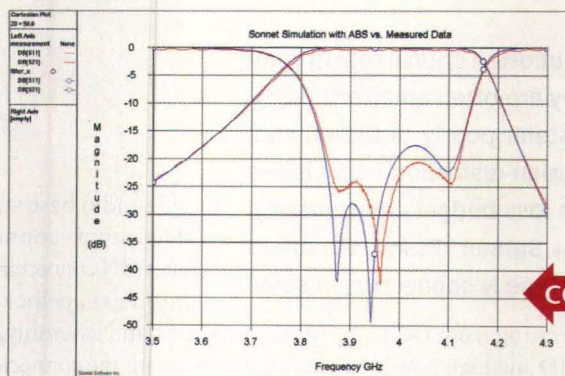


Adaptive Band Synthesis for 3D Planar EM Simulation

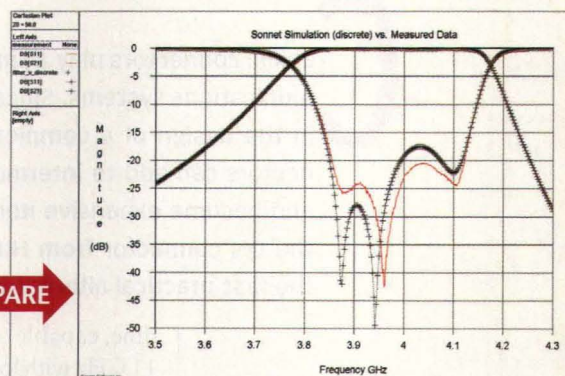
With Sonnet's NEW Adaptive Band Synthesis (ABS) technique, you can achieve detailed simulation results in a small fraction of the time required by point-by-point EM simulation:

1. You enter Start and Stop Frequencies
2. Sonnet's ABS fills in the rest of the band for you with the shortest simulation possible

ABS uses the smallest number of discrete EM simulation samples possible, and provides a broadband S-, Y- or Z-parameter data sweep, cutting overall simulation time dramatically and filling in the fine spectral behavior with no reduction in accuracy! And it's reliable and stable for bandwidths exceeding 100x. Compare the results below between measured and calculated using an ABS sweep based on 4 discrete EM analysis frequencies on the left, and a full discrete frequency by frequency simulation on the right.

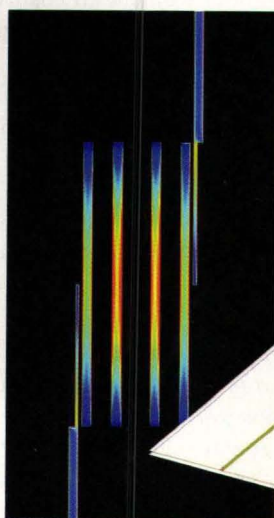


ABS simulation data based on 4 discrete EM analysis frequencies and measured data



300-point Discrete EM analysis and measured data

COMPARE



Superconducting Filter

—Superconductor Technologies, courtesy Dr. George Matthaei.

Current density computed by Sonnet 8.0. Smoothly varying current density along with edge current singularities are evidence of highly accurate EM simulation results.



For sales and evaluation information, please contact



Toll-free in North America 877.776.6638
Phone: 315.453.3096
Fax: 315.451.1694

FREE!

It's not just a demo, it's real software.

Download **Sonnet Lite**— A fully functional EM solver.

visit us at **www.sonnetusa.com**

1020 Seventh North Street, Suite 210
Liverpool, NY 13088 USA

Coaxial Connector Is Type N Alternative

The excellent IMD performance and high-power-handling capability of these new connectors makes them ideal for the transmitter path in mobile radio base stations.

Coaxial connectors play a small but often critical role in communications systems. Since they are often an afterthought in the design of a complex system, poorly designed connectors can add to intermodulation-distortion (IMD) levels and become expensive items in loss budgets. Fortunately, the QN connector from Huber + Suhner (Essex, VT) offers the first practical alternative to Type N connectors in some

mobile-radio base stations.

The quick connect/disconnect QN connector features a unique snap-lock design

that is ideal for hand assembly, requiring about one-tenth the connector/cable assembly time of threaded Type N connectors.

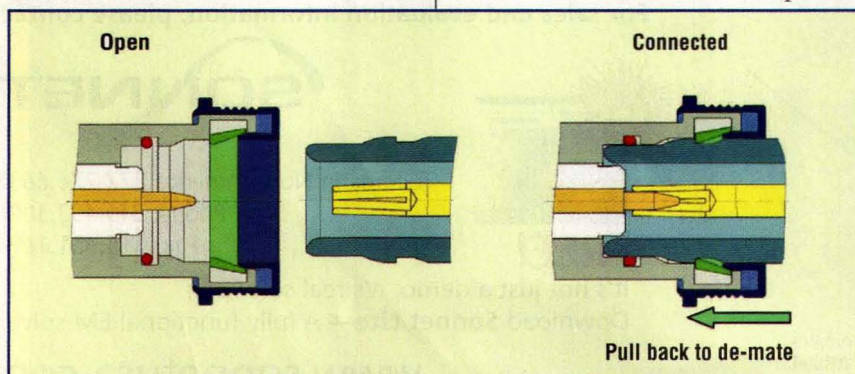
The QN connectors (see figure) are optimized for use from DC to 6 GHz, but exhibit low loss through 11 GHz. They can be fitted on flexible and corrugated cables as well as on semirigid cables, and can handle power levels to 300 W CW at 2.5 GHz. The connectors achieve low levels of IMD, typically better than -155 dBc, making them well suited for use in the transmit path of

mobile-radio base stations. The quick connect/disconnect QN connector features a unique snap-lock design that is ideal for hand assembly, requiring about one-tenth the connector/cable assembly time of threaded Type N connectors. The QN connector's QuickLock mechanism employs a special spring-loaded contact element to ensure steady and uniform contact of the outer conductors; the spring force (and uniform contact) extends all the way around the face of the connector's bush contact.

The new QN connectors support higher package densities than conventional Type N connectors, since wrenches and other tools are not required for assembly (as well as the savings in additional tools).

The QN connectors feature full 360-deg. rotation of the plug to reduce stress on cable assemblies and eliminate the need for retightening hex nuts after installation. The QN connectors are available for use with cables and as panel-mount versions for use with enclosures and packaging. Huber + Suhner, Inc., 19 Thompson Dr., Essex, VT 05452; (802) 878-0555, FAX: (802) 878-9880, Internet: www.hubersuhnerinc.com.

JACK BROWNE
Publisher/Editor



The QN connector features a simple snap-lock mechanism; connectors are de-mated by pulling back on the decoupling sleeve.



BIAS TEES

From **\$25⁹⁵**

RF RF+DC

Easily combines RF+DC signals for your modulation or test requirements.

DC

Now up to 500mA DC current 100kHz-6GHz

With Mini-Circuits Bias-Tees, you can DC connect to the RF port of an active device without effecting its RF properties...modulate a laser, apply DC to an amplifier output, and more! Using statistical process control plus combining magnetics and microstrip, large DC currents may pass through the Bias-Tee without saturation and degradation of performance. At 1/3 to 1/4 the price of competitive units, these new Bias-Tees are available in surface mount, pin, and connectorized models. So why wait, solve your connection problems with Mini-Circuits Bias-Tees.



Mini-Circuits...we're redefining what VALUE is all about!

Model	Freq (MHz) F ₁ -F ₂	Insertion Loss (dB Typ.)			Isolation (dB Typ.)			VSWR (Typ.)	Price \$ ea 1-9 qty.
		L	M	U	L	M	U		
▲ZFBT-4R2G	10-4200	0.15	0.6	0.6	32	40	50	1.13:1	59.95
▲ZFBT-6G	10-6000	0.15	0.6	1.0	32	40	30	1.13:1	79.95
▲ZFBT-4R2GW	0.1-4200	0.15	0.6	0.6	25	40	50	1.13:1	79.95
▲ZFBT-6GW	0.1-6000	0.15	0.6	1.0	25	40	30	1.13:1	89.95
▲ZFBT-4R2G-FT	10-4200	0.15	0.6	0.6	N/A	N/A	N/A	1.13:1	59.95
▲ZFBT-6G-FT	10-6000	0.15	0.6	1.0	N/A	N/A	N/A	1.13:1	79.95
▲ZFBT-4R2GW-FT	0.1-4200	0.15	0.6	0.6	N/A	N/A	N/A	1.13:1	79.95
▲ZFBT-6GW-FT	0.1-6000	0.15	0.6	1.0	N/A	N/A	N/A	1.13:1	89.95
★ZBNT-60-1W	2.5-6000	0.2	0.6	1.6	75	45	35	1.35:1	82.95
■PBTC-1G	10-1000	0.15	0.3	0.3	27	33	30	1.10:1	25.95
■PBTC-3G	10-3000	0.15	0.3	1.0	27	30	35	1.60:1	35.95
■PBTC-1GW	0.1-1000	0.15	0.3	0.3	25	33	30	1.10:1	35.95
■PBTC-3GW	0.1-3000	0.15	0.3	1.0	25	30	35	1.60:1	46.95
●JEBT-4R2G	10-4200	0.15	0.6	0.6	32	40	40	-	39.95
●JEBT-6G	10-6000	0.15	0.7	1.3	32	40	40	-	59.95
●JEBT-4R2GW	0.1-4200	0.15	0.6	0.6	25	40	40	-	59.95
●JEBT-6GW	0.1-6000	0.15	0.7	1.3	25	40	30	-	69.95

L = Low Range M = Mid Range U = Upper Range

NOTE: Isolation dB applies to DC to (RF) and DC to (RF+DC) ports.

▲SMA Models, FT Models Have Feedthrough Terminal ★Type N, BNC Female at DC

■Pin Models ●Surface Mount Models

Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: <http://www.minicircuits.com>

ISO 9001 CERTIFIED

F 164 Rev B

Combiners/Dividers Range 0.8 To 3.0 GHz

These ruggedly built power splitters and combiners/dividers are designed to minimize losses and distortion when handling moderate to high power levels to 3 GHz.

Power combiners/dividers are invaluable components when summing the contributions of multiple power amplifiers (PAs) or splitting signals into lower-power multiple signals. A line of power combiners/dividers from MECA Electronics (Denville, NJ) combine the traits most desirable in this type of component, including low insertion loss, low VSWR, good power-handling capabilities, and high isolation

way power splitters measure $5.25 \times 1.00 \times 0.81$ in. ($13.34 \times 2.54 \times 2.1$ cm) and are supplied with Type N female

between channels. The components detailed here range in frequency from 0.8 to 3.0 GHz, making them applicable for all cellular, personal-communications-services (PCS) and wireless-local-area-network (WLAN) systems.

The broadest-frequency models include two-way power splitter model R2N-1.900-M01 and three-way power splitter model R3N-1.900-M01, both for use from 0.8 to 3.0 GHz. The two-way splitter features 1.10:1 typical VSWR and 1.20:1 maximum VSWR with 0.3 dB typical insertion loss. The amplitude imbalance is typically 0.1 dB. The worst-case phase imbalance is 2 deg. The two-way splitter handles RF input power levels to 200 W.

Three-way power splitter model R3N-1.900-M01 exhibits typical VSWR of 1.15:1. The typical insertion loss is 0.3 dB. The amplitude imbalance is typically 0.1 dB with worst-case performance of 0.2 dB. The maximum phase imbalance is 3 deg. The three-way power splitter also handles input levels as high as 200 W. Both the two- and three-

way power splitters measure 5.25 × 1.00 × 0.81 in. (13.34 × 2.54 × 2.1 cm) and are supplied with Type N female connectors. The connectors are constructed with silver-plated brass to minimize passive intermodulation distortion (PID) in wireless communications systems. The splitters are rated for operating temperatures from -55 to +85°C.

At lower frequencies, in cases where high port-to-port isolation is desired, the company offers the two-way model H2N-0.900 power combiner/divider and the four-way model H4N-0.900 power combiner/divider, both from applications from 0.8 to 1.0 GHz (see figure). The two-way component features typical VSWR of 1.10:1 with typical insertion loss of 0.2 dB. The worst-case amplitude imbalance is 0.1 dB while the worst-case phase imbalance is 2 deg. Isolation between ports is at least 20 dB. The combiner/divider handles a total of 100 W RF power, or 25 W maximum per port. MECA Electronics, Inc., 459 East Main St., Denville, NJ 07834; (866) 444-MECA, (973) 625-0661, FAX: (973) 625-1258, e-mail: sales@e-meca.com, Internet: www.e-meca.com.

JACK BROWNE
Publisher/Editor

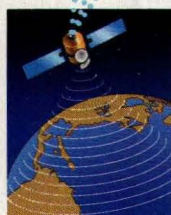


The four-way model H4N-0.900 power combiner/divider (left) and the two-way model H2N-0.900 power combiner/divider (right) are designed for use from 0.8 to 1.0 GHz.

THE GLOBAL SOLUTION... AND BEYOND!



10MHz to 7GHz AMPLIFIERS **\$99⁹⁵** from (1-9 qty.)



From amateur radio to cellular to satellite applications, with medium output power up to 17dBm, Mini-Circuits versatile ZJL and ZKL connectorized amplifiers offer the broad range of choices designers demand for achieving high system performance goals. Ultra-wideband models deliver **gain ranging from 9 to 40dB** and IP3 up to +32dBm. But beyond the performance and reliability built into these miniature 12V amplifiers lies another important feature, the low price...from only \$99.95! Call now for fast delivery.

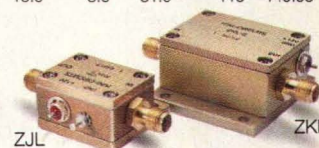
Mini-Circuits...we're redefining what VALUE is all about!

SPECIFICATIONS

Model	Freq (MHz)	Gain (typ) Midband (dB)	Flat (±dB)	Max. P _{out} ¹ (dBm)	Dynamic Range (Typ @2GHz ²) NF(dB) IP3(dBm)	I(mA) ³	Price \$ea. (1-9)
ZJL-5G	20-5000	9.0	±0.55	15.0	8.5 32.0	80	129.95
ZJL-7G	20-7000	10.0	±1.0	8.0	5.0 24.0	50	99.95
ZJL-4G	20-4000	12.4	±0.25	13.5	5.5 30.5	75	129.95
ZJL-6G	20-6000	13.0	±1.6	9.0	4.5 24.0	50	114.95
ZJL-4HG	20-4000	17.0	±1.5	15.0	4.5 30.5	75	129.95
ZJL-3G	20-3000	19.0	±2.2	8.0	3.8 22.0	45	114.95
ZKL-2R7	10-2700	24.0	±0.7	13.0	5.0 30.0	120	149.95
ZKL-2R5	10-2500	30.0	±1.5	15.0	5.0 31.0	120	149.95
ZKL-2	10-2000	33.5	±1.0	15.0	4.0 31.0	120	149.95
ZKL-1R5	10-1500	40.0	±1.2	15.0	3.0 31.0	115	149.95

NOTES:

1. Typical at 1dB compression.
2. ZKL dynamic range specified at 1GHz.
3. All units at 12V DC.



Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718)332-4661 **INTERNET** <http://www.minicircuits.com>

For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE • EEM • MICROWAVE PRODUCT DATA DIRECTORY • WWW.RFGLOBALNET.COM

ISO 9001 CERTIFIED

F 232 Rev D

Times Microwave Systems Tech Center



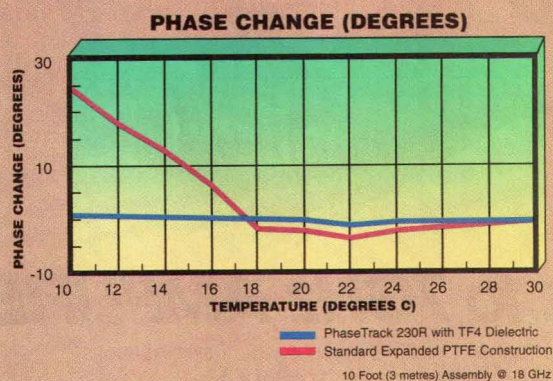
PhaseTrack™

Ultra Phase Stable Test Cable and Assemblies

PhaseTrack™ Test Cables provide unmatched phase stability and tracking performance over a wide temperature range — providing significantly improved measurement accuracy and repeatability not previously available. These advanced technology test cables utilize the proprietary Times Microwave Systems TF4™ dielectric, which has unique thermal stability properties. This results in significantly less phase change over temperature performance than any other solid or "high performance" expanded PTFE dielectric cable types available anywhere today. By using PhaseTrack™ cables with your Vector Network Analyzer, you can be sure of excellent retention for test equipment calibration, even when the temperature of the testing environment changes over a very wide range. Our sales engineers can help you to specify the best product for your application.

Features & Benefits:

- Minimal Phase Change over Temperature
- Superior Phase Stability with Bending
- Operates to 18 GHz
- Field Interchangeable Connectors
- High Performance TNC, N, SMA, 7mm and 7/16 DIN Connectors Available
- Long Term Electrical Stability
- Rugged Construction



Applications:

- Test Laboratories
- Field Test and Verification
- Military Systems Interconnect Use
- Upgrade or Replacement of Damaged or Obsolete Microwave/RF Test Cables
- Quality and Maintenance Test Programs

Times Microwave Systems is the leader in the development of RF and Microwave interconnect solutions for military, wireless, precision testing and other applications. To keep up to date on our latest developments look for additional Tech Center releases .



Antenna Is Available For US And European Bands

A LOW-COST PLANAR antenna is available in standard or custom frequencies from 300 to 900 MHz to meet worldwide frequency allocations. The "Splatch" utilizes a proprietary grounded-line technique to extract good performance from a tiny surface-mount element. Unlike many compact antennas, the "Splatch" is highly immune to proximity effects, making it suitable to handheld applications such



as remote controls, pagers, and alert devices. The antenna's SMD package is appropriate for reflow or hand attachment. The antenna measures $1.1 \times 0.5 \times 0.062$ in. ($2.8 \times 1.27 \times 0.157$ cm) and exhibits a 50- Ω characteristic impedance and a VSWR of less than 1.9. P&A: Less than \$1.00 in production quantities.

Antenna Factor, 575 SE Ashley Pl., Grants Pass, OR 97526; (541) 956-0931, FAX: (541) 471-6251, Internet: www.antennafactor.com.

High IP3 Amps Suit PCS/3G Applications

A PAIR OF HIGH output IP3 GaAs InGaP HBT MMIC amplifiers cover applications from 1.7 to 2.5 GHz. The HMC455LP3 and HMC461LP3 amplifiers are suited for a variety of PCS/3G wireless infrastructure applications offering +19 and +20 dBm WCDMA channel output power respectively at -45 dBc ACP. The 0.5-W HMC455LP3 provides 13 dB of gain and +28 dBm of saturated power at 56 percent PAE from a single +5-VDC supply voltage. This MMIC amplifier uses a minimum number of external components, has high output IP3 of +42 dBm, and low VSWR of 1.4:1. The 1-W HMC461LP3 offers the linear performance of two HMC455LP3s in a

single IC yielding an output IP3 of +45 dBm. It can be configured in a balanced or push-pull amplifier circuit providing 12 dB of gain and +30.5 dBm of saturated power at 48 percent PAE from a single +5-VDC supply voltage. Both amplifiers are packaged in low-cost, leadless QFN

3 \times 3-mm surface-mount packages. P&A: Sample and production quantities are available.

Hittite Microwave Corp., 12 Elizabeth Dr., Chelmsford, MA 01824; (978) 250-3343, FAX: (978) 250-3373, Internet: www.hittite.com.

WEINSCHEL POWER SPLITTERS & DIVIDERS

Products That Make a World of Difference

SERVICE, SELECTION, SUPPORT...

Weinschel offers a wide variety of High Performance Resistive Power Splitters and Dividers. Our Power Splitters and Dividers are not just the highest level of performance and quality you have come to expect with every Weinschel product, but are priced to satisfy your budget!

- Miniature and Light Weight
- Accurate Division of Outputs
- Operating Frequency Ranges Up to 40 GHz
- Low Insertion Loss, Nominal 6 dB
- Precise Output Power Symmetry
- Connector Options Available
- 4 Way Divider Designs
- Custom Configurations, Our Specialty



	SPLITTERS					DIVIDERS				
Model	1507R*	1870A*	1579*	1593	1534	1549R	1515*	1506A*	1580*	1575
Freq Range (GHz)	dc-4.0	dc-18	dc-26.5	dc-26.5	dc-40.0	dc-40.0	dc-18	dc-18	dc-26.5	dc-40.0
MAX SWR @ Max Freq	1.15	1.15	1.35	1.22	TBD	1.25	1.35	1.35	1.55	1.70
AMP Tracking (Max dB)	0.20	0.20	0.40	0.25	0.50	0.20	0.50	0.50	1.00	0.60
Connector Types	SMA (f) all ports	Type N (f) all ports	3.5 mm (f) all ports	3.5 mm (f) all ports	2.92 mm (f) all ports	SMA (f) all ports	SMA (m) IN SMA (f) OUT	Type N (f) all ports	3.5 mm (m) IN 3.5 mm (f) OUT	2.92 mm (f) all ports

* EXPRESS shipment available through Sickles Distribution Sales at 800-542-4457 or sales@rsickles.com

4 WAY DIVIDERS

Model	1550	1574
Freq Range (GHz)	dc-2.0	dc-18
MAX SWR @ Max Freq	1.70	1.300
Tracking (Max dB)	0.25	2.50
Connector Types	SMA (f) all ports	3.5 mm (f) all ports



MCE
WEINSCHEL

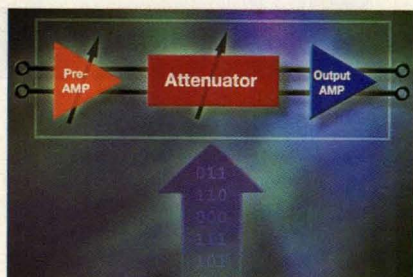
5305 Spectrum Drive, Frederick, Maryland 21703-7362
800-638-2048 • Tel: 301-846-9222 • Fax: 301-846-9116
e-mail: sales@weinschel.com • Web: www.weinschel.com



Certificate No. 94-289D

VGA Features Wide Bandwidth

THE AD8370 IS A high-linearity, fully differential, digitally controlled, variable-gain amplifier (VGA) designed for use in wireless and wired communication networks. The AD8370 provides a 700-MHz bandwidth (-3 dB), enabling the part to be



used at intermediate frequencies (IFs) up to 380 MHz. The AD8370 enables designers to select between two gain-control ranges (a high-gain mode adjustable from $+6$ to $+34$ dB and a low-gain adjustable from -11 to 17 dB) through a 3-b serial

interface. P&A: Samples and pre-production quantities are available for immediate shipment. The AD8370 is priced at \$4.20 per unit in 1000-piece quantities.

Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106; (781) 329-4700, FAX: (781) 326-8703, Internet: www.analog.com.

Simulation Software Provides Accurate Analysis

WAVE-ENABLED SOFTWARE FOR the advanced analysis of printed-circuit boards (PCBs), components, and packages addresses the rigorous demands placed on high-speed designers. SIwave is the only signal-integrity tool on the market to allow both frequency- and time-domain results to be generated from a physical description of the device, allowing engineers to model not only individual components, but also entire PCBs and package structures.

Ansoft Corp., Four Station Square, Suite 200, Pittsburgh, PA 15219-1119; (412) 261-3200, FAX: (412) 471-9427, e-mail: info@ansoft.com.

LNAs Are Applicable For Satellite Service & Radar

A LINE OF low-noise amplifiers (LNAs) in the frequency bands of 8 to 10 GHz (Model NLC00408), 10 to 12 GHz (Model NLC00409), 12 to 13 GHz (Model NLC00411), 13 to 14 GHz (Model NLC00412), and 14 to 15 GHz (Model NLC00413) is applicable for Satellite Service and Radar. A thin-film-hybrid MIC process is used to achieve robust characteristics over a temperature range of -30 to $+70^{\circ}\text{C}$.

Nextec Microwave & RF, Inc., 3350 Scott Blvd., Bldg. 49, Santa Clara, CA 95054; (408) 727-1189, FAX: (408) 727-5915, Internet: www.nextec-rf.com.

make INMET your sole source for: Attenuators Terminations Equalizers Bias Tees



**MCE
INMET**

Ann Arbor, MI 48103



Call: 888-244-6638 or 734-426-5553 • Fax: 734-426-5557 • WEB: www.inmetcorp.com

Manufacturer of Attenuators • Adapters • Bias Tees • DC Blocks • Equalizers • Terminations • Connectors

Specify INMET for dependable, quality, coaxial components. There are over 3,000 variations of precision and low cost products including attenuators, terminations, in-series and between-series adapters, dc blocks, bias tees and gain equalizers. Visit www.inmetcorp.com to view the complete product line with respective data sheets . . . and get a quote while you are there. You'll be glad you did.

We Design And Manufacture To Meet Your Requirements Prototype or Production Quantities

800-522-2253

This Number May Not
Save Your Life...

But it could make it a lot easier!
Especially when it comes to ordering
non-standard connectors.

**RF/MICROWAVE CONNECTORS
CABLES & ASSEMBLIES**

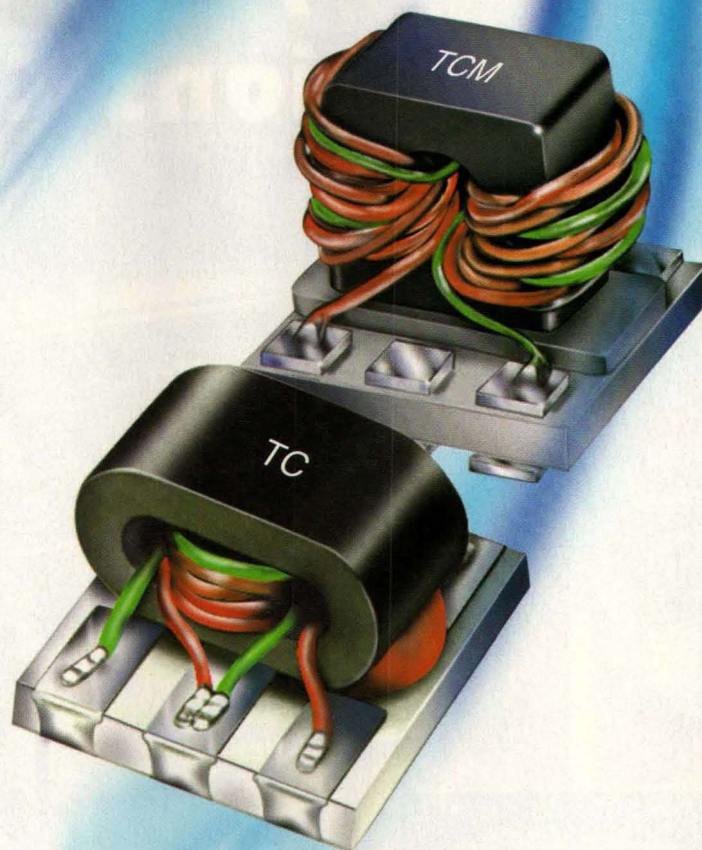
Specials our specialty. Virtually any
SMA, N, TNC, BNC, SMB, or SMC
delivered in 2-4 weeks.

Connectors supplied to
your drawings and specs.

Extensive inventory of passive RF/Microwave
components including attenuators,
terminations and dividers.

NEMAL ELECTRONICS INTERNATIONAL, INC.
12240 NE 14 AVENUE • NORTH MIAMI, FL 33161
TEL: 305-899-0900 • FAX: 305-895-8178
BRASIL: (011) 5535-2368
E-MAIL: INFO@NEMAL.COM
URL: WWW.NEMAL.COM

RF TRANSFORMERS



.3-2500MHz as low as **99¢** **IN STOCK** each (qty. 100)

It used to be that small RF transformers with high end performance cost a lot, but not since Mini-Circuits introduced the all ceramic TC and high strength plastic TCM families. Now you can get impedance ratios from 0.1:1 to 16:1 ohms with good return loss and broad bandwidths from 0.3 to 2500MHz at price buster values. Plus, these ultra-small performers have all-welded, solder plated leads for highly reliable pick-up and solderability during automated assembly. So have it both ways; high performance AND low price with Mini-Circuits TC and TCM surface mount transformers.



PLASTIC CASE

Model	Ω Ratio & Config.	Freq. (MHz)	Ins. Loss* 1dB (MHz)	Price \$ea. (qty. 100)
TCM1-1	1C	1.5-500	5-350	.99
TCML1-11	1G	600-1100	700-1000	1.09
TCML1-19	1G	800-1900	900-1400	1.09
TCM2-1T	2A	3-300	3-300	1.09
TCM3-1T	3A	2-500	5-300	1.09
TCM4-4	4B	0.5-400	5-100	1.29
TCM4-1W	4A	3-800	10-100	.99
TCM4-6T	4A	1.5-600	3-350	1.19
TCM4-14	4A	200-1400	800-1000	1.09
TCM4-19	4H	10-1900	30-700	1.09
TCM4-25	4H	500-2500	750-1200	1.09
TCM8-1	8A	2-500	10-100	.99
TCM9-1	9A	2-280	5-100	1.19



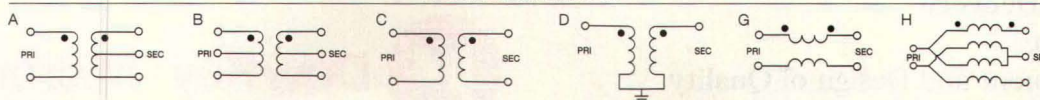
CERAMIC CASE

Model	Ω Ratio & Config.	Freq. (MHz)	Ins. Loss* 1dB (MHz)	Price \$ea. (qty. 100)
TC1-1T	1A	0.4-500	1-100	1.19
TC1-1	1C	1.5-500	5-350	1.19
TC1-15	1C	800-1500	800-1500	1.29
TC1.5-1	1.5D	.5-2200	2-1100	1.59
TC2-1T	2A	3-300	3-300	1.29
TC3-1T	3A	5-300	5-300	1.29
TC4-1T	4A	5-300	1.5-100	1.19
TC4-1W	4A	3-800	10-100	1.19
TC4-14	4A	200-1400	800-1100	1.29
TC8-1	8A	2-500	10-100	1.19
TC9-1	9A	2-200	5-40	1.29
TC16-1T	16A	20-300	50-150	1.59
TC4-11	50/12.5D	2-1100	5-700	1.59
TC9-1-75	75/8D	0.3-475	0.9-370	1.59

Detailed Performance Data & Specs Online at: www.minicircuits.com/model

Dimensions (LxW): TCM .15" x .16" TC .15" x .15" *Referenced to midband loss.

ELECTRICAL CONFIGURATIONS



Mini-Circuits®

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For quick access to product information see MINI-CIRCUITS CATALOG & WEB SITE



The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

ISO 9001 ISO 14001 CERTIFIED

377 Rev. A

Military

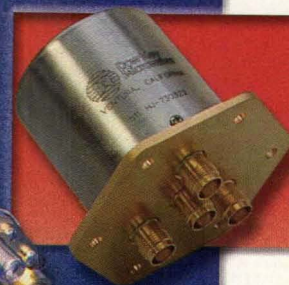
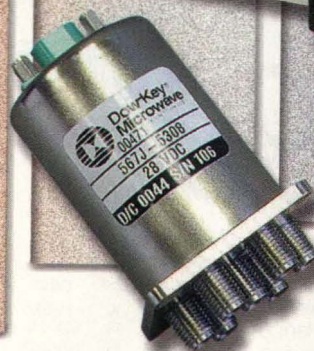
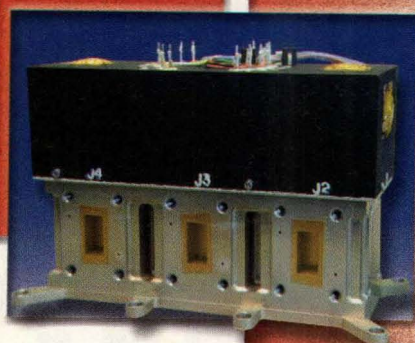


Dow-Key Microwave The Solutions Company

Space



Commercial



- Commercial – Military – Space
- Worldwide
- Coaxial Switches to Waveguide to Intricate Switch Matrices – DC to 26.5 GHz
- Innovative R&D
- On-time Delivery
- Low Cost
- Development and Design of Quality Solutions Meeting Market Demands

*We have the answers.....
All you have to do is ask the questions.*

**Dow-Key Offers
Leading-Edge Solutions
to Fit Your Requirements**



DowKey® Microwave
CORPORATION

A DOVER COMPANY

4822 McGrath Street • Ventura, CA 93003-5641
Tel: (805) 650-0260 • Fax: (805) 650-1734
Visit us at www.dowkey.com



Laboratory (RF) MicroProbe Station

**Extremely Low Cost
RF/Microwave
Test Environment**

A ultra compact, manually operated probe station for engineers, scientists and students. Measure Microwave, RF and IV parameters of Semiconductor Devices. Characterize MEMS, wireless, photonic and nanoelectronic components and assemblies.

- Benchtop Size (<1ft²) • 2" Vacuum chuck • 1" X-Y-Z stage with z-lift • 2 ea. 0.5" X-Y-Z probe positioners, includes 2 ea. 18 GHz probes • 10X/30X Stereo Zoom Microscope • Fluorescent Illuminator • Compatible with additional Magnetic Mount Positioners (optional) • Compatible with industry standard microwave probes (optional)

• Cost effective as a dedicated test station •

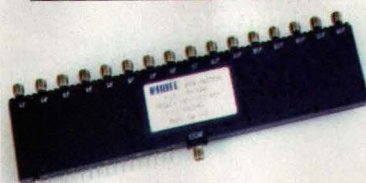


J microTechnology
3744 NW Bluegrass Pl
Portland, OR 97229
(503) 614-9509
(503) 531-9325 (FAX)
www.jmicrotechnology.com

Research Performance / Student Price

J MICROTECHNOLOGY

SP16T Pin-Diode Switch (0.5-18 GHz)



UMCC's Model SR-U010-16S is an absorptive sixteen-throw solid state switch operating over 0.5-18 GHz. Switch features: 7.0 dB loss / 60dB Isolation at 18 GHz, 2:1 VSWR, 25ns Rise/Fall time, +5/-12 VDC Supplies, CMOS or TTL controls, all removable connectors. Unit measures 1.6" x 8.0" x 0.4".

Product Line:

- Solid State Variable Attenuators
- DC-Blocks, Bias Tee's, Transformers
- Directional Couplers
- Hybrid Couplers (90°/180°)
- Power Dividers / Combiners
- Solid State Switches
- Special Function Subsystems

Universal Microwave Components Corporation

5702-D General Washington Drive
Alexandria, Virginia 22312
Tel: (703) 642-6332, Fax: (703) 642-2568
Email: UMCC@UMCC111.Com
Web: www.umcc111.com



UNIVERSAL MICROWAVE

SIGNAL GENERATORS



Seven compact, programmable models cover 0.5 to 26.5 GHz with 1 MHz resolution. Prices start at \$4,250

April Instrument
Sunnyvale, CA

www.aprilinstrument.com

Tel: (650) 964-8379 Fax: (650) 965-3711

APRIL INSTRUMENTS

DeskTop Antenna Measurement System For Wireless Development



- DC-6, 12 & 18 GHz
- 2-Axis Data
- Parallel Port
- De-Embed System
- 20ft. 18GHz
- Cable
- Laser Module
- Bias Injection
- Free Software
- Custom Cables
- Gain Slopes
- Group Delay
- 3-D (0, f)

Download Demo
Software Ver 2.0 offers swept freq. at each movement :< Interfaces with most hp VNA's

Diamond Engineering
484 Main St. Diamond Springs, Ca 95619
(530)-626-3857 www.diamondeng.net
www.MicrowaveRF.com

DIAMOND ENGINEERING

LINEAR RF

WATTS

0.0 1 MHz 1 GHz

BROADBAND RF:

- LA Series - Linear Amplifier
- Up to 1 GHz
- Up to 300 Watts
- New Design Solutions

T&C Power Conversion, Inc.

110 Halstead Street #7 Phone: 1-585-482-5551
Rochester, New York 14610 USA Fax: 1-585-482-8487
<http://www.tcpowerconversion.com>

T & C POWER CONVERSION

CHIP ANTENNA BREAKTHROUGH

- 802.11
- ZigBee
- Home RF
- BlueTooth
- Telemetry
- Lan Cards
- Data Collection
- Tracking/Positioning

2.4GHz & GPS

ACTUAL SIZE

ANTENNA FACTOR

800-489-1634
575 S.E. ASHLEY PL.
GRANTS PASS, OR 97526

LINX TECHNOLOGIES

Polyfet has equivalents to

- | | |
|---------|----------|
| MRF134 | MRF171A |
| MRF136 | MRF173 |
| MRF136Y | MRF173CQ |
| MRF140 | MRF174 |
| MRF141 | MRF175GU |
| MRF141G | MRF175GV |
| MRF148 | MRF175LU |
| MRF150 | MRF176GU |
| MRF151 | MRF176GV |
| MRF151G | MRF177 |
| MRF160 | MRF275G |
| MRF161C | MRF275L |
| MRF161W | |

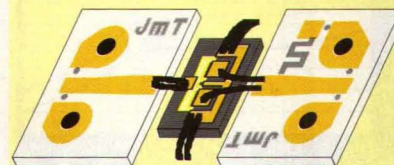
polyfet rf devices

Contact / View us on the WEB at
<http://www.polyfet.com>

1110 Avenida Acaso, Camarillo, CA, 93012
TEL (805) 484-4210 FAX (805) 484-3393

POLYFET RF DEVICES

ProbePoint™ CPW-μStrip Adapter Substrates



- Precision CPW to μStrip Adapter Substrates
- Companion Calibration Substrates and Standards
- Accurate Electrical Data to Frequencies >50 GHz

- 5, 10, & 15 mil thickness
- Compatible with 40GHz+ probes
- Standard and Custom Calibration Standards



J microTechnology
3744 NW Bluegrass Pl
Portland, OR 97229
(503) 614-9509
(503) 531-9325 (FAX)
www.jmicrotechnology.com

Test Tooling for the Untestable

J MICROTECHNOLOGY



**SMD
Test
Fixture**
Cost Effective
'Clam Shell'

A compact, rugged, modestly priced, manually operated SMD Test Fixture developed for the characterization of surface mount devices. A general purpose 'mainframe' with wide range of standard and custom carrier inserts to accommodate dozens of package styles.

- Repeatability CPW test environment • 4-port capability •
- 10 GHz operation • Standard carrier inserts for popular packages •
- Custom carrier inserts for proprietary packages • Easy reconfiguration •
- Standard calibration routines •
- Enhanced calibration software available •
- Test active and passive 2-, 3-, 4-port surface mount components •



J microTechnology
3744 NW Bluegrass Pl
Portland, OR 97229
(503) 614-9509
(503) 531-9325 [FAX]
www.jmicrotechnology.com

Low Cost, Quick Setup, Easy to Use

J MICROTECHNOLOGY

E

Frequency Multipliers

Wilmanco
www.wilmanco.com
Tel: (805) 523-2390 Fax: (805) 529-0892
E-mail: williams@wilmanco.com

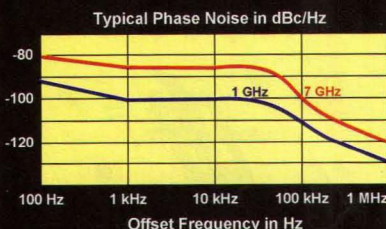
WILMANCO

NEW FREQUENCY SYNTHESIZERS



SLISM4 synthesizer design offers great performance at a **low cost!**

- to 8 GHz (up to octave bands)
- freq. steps as low as **1 kHz**
- output power +13 dBm (min)
- Ref.; Ext. or Int. (**±1PPM**)
- 2.5" x 2.5" x 0.6" EMI Package
- serial control, +5V operation



Your Source for World Class
Performance, Quality & Low Cost

luff RESEARCH, INC

20 N. Tyson Ave., Floral Park, NY 11001
Tel: (516) 358-2880 Fax: (516) 358-2757
Web: www.luffresearch.com
E-mail: sales@luffresearch.com

LUFF RESEARCH

LOW NOISE AMPLIFIERS

www.SATELLINK.COM

NOISE TEMPERATURE (K)

FREQUENCY (GHz)

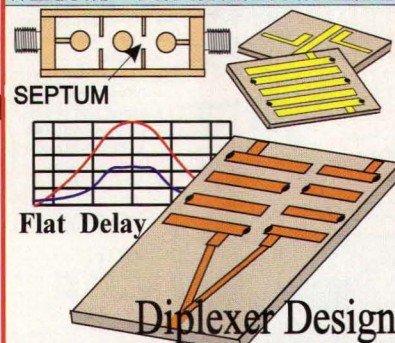
UNCOOLED 23°C TE COOLED

SATELLINK, INC.
3525 MILLER PARK DR.
GARLAND, TX 75042
CALL (972) 487-1434
FAX (972) 487-1204

SATELLINK

WAVECON Circuit & Filter Design Software

Windows™ 95/98/NT/2000/ME/XP



P.O. Box 2697, Escondido, CA 92033
Tel: (760) 747-6922 Fax: (760) 747-5270
Website: www.waveconsoft.com

WAVECON

Wireless Product Development

The "Part 15" Experts
UHF, 915 MHz, 2.4 GHz



Two Way Data

- Spread Spectrum Data Modems
- Bluetooth™
- RFID
- Narrow Band Links



One Way Data

- Resource Management
- Instrumentation
- Security
- Tracking

APEX

WIRELESS, INC.

2525 Frontier Ave., Suite 200, Boulder, CO 80301
(303) 443-6699, EXT. 26 FAX (303) 442-7123
e-mail: rf@apexwireless.com www.apexwireless.com

APEX WIRELESS

PDD

Your Online Resource

For RF and Microwave Products and Manufacturers

If you need a part, you'll find it at:

www.m-rf.com

Advertiser	Website, E-Mail Address	Page
A		
Advanced Power Technology	www.advancedpower.com	66
Agilent Epsg	www.agilent.com/find/mwtools	Cov 2
Amplifier Research	www.amplifiers.com/microwave.asp	97
American Technical Ceramics	www.atceramics.com; e-mail: sales@atceramics.com	29
Anritsu Company	www.us.anritsu.com/family/126	11
Ansoft Corporation	www.ansoft.com/ansoftdesigner	83, 84-85
Analog Devices	www.analog.com/rf	57, 59
Anaren Microwave Inc.	www.anaren.com	Cov 4
Antenna Factor	www.antennafactor.com	109
April Instruments	www.aprilinstrument.com	109
Applied Wave Research	www.mwoffice.com	38
Apex Wireless Inc.	www.apexwireless.com; e-mail: rf@apexwireless.com	110
Arra Inc.	www.arra.com	Cov 3
Avnet RF & Microwaves	www.avnetRF.com/passiveguideMWRf	20
C		
California Eastern Lab	www.cel.com/switches.asp	4
Cap Wireless Inc.	www.capwireless.com	71
Ciao Wireless Inc.	www.CiaoWireless.com; e-mail: Sales@CiaoWireless.com	17
Computer Simulation Technology	www.cst-world.com; e-mail: info@cst-america.com	44
Communications Techniques	www.cti-com; e-mail: sales@cti-inc.com	92
D		
DBM, LLC	www.dbmcorp.com	54
Diamond Engineering	www.MicrowaveRF.com	109
Digi-Key	www.digikey.com	3
Dow-Key Microwave	www.dowkey.com	108
E		
Eagleware	www.eagleware.com; e-mail: sales@eagleware.com	65
Elcom Technologies	www.elcom-tech.com	16
EIC Corporation	www.eiccorp.com	39
F		
Filtron Solid State	www.filcs.com	12
H		
Herley Industries	www.herley.com; e-mail: sales@genairmicrowave.com	76
Harbour Industries Inc.	www.harbourind.com	98
Herotek Inc.	www.herotek.com; e-mail: info@herotek.com	58
Hittite Microwave	www.hittite.com	96
Huber & Suhner, Inc.	www.hubersuhnerinc.com	10
I		
ITT Industries	www.ittmicrowave.com	32
J		
J Microtechnology	www.jmicrotechnology.com	109, 110
JCA Technology	www.jcatech.com; e-mail: jca@jcatech.com	2
JFW Industries Inc.	www.jfwindustries.com; e-mail: sales@jfwindustries.com	74
K		
K&L Microwave/Dover	www.klmicrowave.com	6
L		
Lemos International Co Inc	www.lemosint.com	46
Linear Technology Corporation	www.linear.com	79
Lucix Corporation	www.lucix.com	64
Luff Research	www.luffresearch.com; e-mail: sales@luffresearch.com	110
M		
Maxim Integrated Products	www.maxim-ic.com	75
Maury Microwave Inc.	www.murymw.com	22
Meca Electronics, Inc.	www.e-meca.com; e-mail: sales@e-meca.com	34
MCE Innet Corp.	www.innetcorp.com	106
MDL, Inc.	www.mdlab.com	70
Merrimac Industries Inc.	www.merrimacind.com	89
Mid-Atlantic RF Systems Inc.	www.midatlanticrof.com; e-mail: info@midatlanticrof.com	112
Mimix Broadband	www.mimixbroadband.com	52
Mini-Circuits/SCI Components	www.minicircuits.com	14-15, 27, 30-31, 35, 47, 49, 51, 55
Mini-Circuits/SCI Components	www.minicircuits.com	73, 77, 87, 91, 95
Mini-Circuits/SCI Components	www.minicircuits.com	101, 103, 107
Microwave Journal	www.mwjjournal.com; e-mail: mwj@mwjournal.com	82
Midwest Microwave	www.midwest-microwave.com; e-mail: sales@midwest-microwave.com	80
MITEQ MEDIA	www.miteq.com	1, 24-25
N		
Narda An L-3 Communications	www.nardamicrowave.com; e-mail: nardaeast@L-3com.com	21
Nemal Electronics Intl Inc	www.nemal.com; e-mail: info@nemal.com	106
Noisecom	www.noisecom.com; e-mail: info@noisecom.com	7
P		
Phonon Corporation	www.phonon.com; e-mail: saw@phonon.com	64
Philips Semiconductors	www.semiconductor.philips.com/connectivity	8-9
Polyfet RF Devices	www.polyfet.com	109
Programmed Test Sources Inc.	www.programmedtest.com	42
R		
RFHIC Company	www.rfhic.com; e-mail: rfsales@rfhic.com	48
RF Micro Devices	www.rfmd.com	67, 69
Richardson Electronics	www.rfwireless.rell.com/tmcat.asp; e-mail: rwc@rell.com	18
S		
Sawtek Inc.	www.sawtek.com; e-mail: info@sawtek.com	19
Satellink	www.satellink.com	110
Sonnet Software Inc.	www.sonnetusa.com	99
Skyworks Solution Inc.	www.skyworksinc.com	36-37
Spectrum Elektrotechnik GmbH	www.spectrum-et.com	81
State Of The Art	www.resistor.com; e-mail: sales@resistor.com	68
Stratedge	www.stratedge.com/mwrf	93
Synergy Microwave	www.synergymw.com; e-mail: sales@synergymw.com	41, 61, 63
T		
T&C Power Conversion Inc.	www.tcpowerconversion.com	109
Times Microwave Systems	www.timesmicrowave.com	104
TTE Incorporated	www.tte.com	13
U		
Universal Microwave Components	www.umcc111.com; e-mail: UMCC@UMCC111.com	109
V		
Voltronics Frequency Control Products Inc	www.voltronicsfcp.com; e-mail: info@voltronicsfcp.com	56
Voltronics International Corp	www.VoltronicsCorp.com; e-mail: info@voltronicscorp.com	78
W		
Wavecon	www.waveconsoft.com	110
Weinschel Corp	www.weinschel.com; e-mail: sales@weinschel.com	105
Wilmanco	www.wilmanco.com; e-mail: williams@wilmanco.com	110
WL Gore & Associates Inc.	www.goreelectronics.com/info/mw2	43

*Domestic Edition only **International Edition only This index is provided as an additional service by the publisher, who assumes no responsibility for errors or omissions.

MICROWAVES & RF ENGINEERING CAREERS

CAREER OPPORTUNITIES NATIONWIDE

EXPERIENCED AND DEGREEED ENGINEERS FOR TOP DEFENSE AND COMMERCIAL COMPANIES. EXPERIENCE IN ALL OR SOME OF THE FOLLOWING DISCIPLINES NEEDED FROM ENGINEERING-LEVEL TO VP LEVEL: OSCILLATORS/MULTIPLEXERS/TRANSCEIVERS/RECEIVERS/ SYNTHESIZERS/RF/MICROWAVE-HARD ENGINEERING/ MARKETING/BUS DEV/ENGINEERING

E-MAIL RESUME TO: pma820@yahoo.com.

RATES

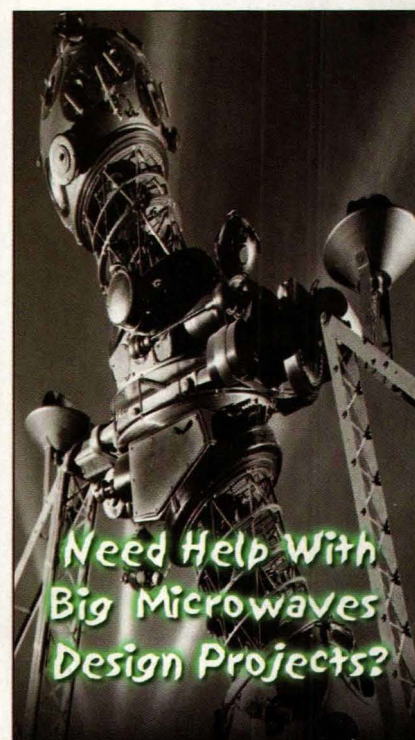
Effective January 1, 2003
\$225 per column inch
Commissionable to agencies

DEADLINES

Space reservation:
5th of month preceding issue date
Ad material to:
Penton Media Inc., Classified Dept.
45 Eisenhower Dr., fifth floor
Paramus, NJ 07652

SALES STAFF

JoAnne Reppas
(201) 666-6698
Fax: (201) 666-0557
e-mail: jrepfrangides@msn.com



Need Help With
Big Microwaves
Design Projects?

Your gateway site to

Planet EE
Penton Electronics Group

Microwaves & RF

www.mwrf.com

MID-ATLANTIC RF SYSTEMS... SPECIALIZES IN SMALL QUANTITY ORDERS.

DESIGN &
MANUFACTURING

CUSTOM &
STANDARD
APPLICATIONS

QUALITY
SERVICE



Mid-Atlantic RF Systems offers creative solutions for your most demanding requirements for RF microwave components and systems.

Mid-Atlantic Products

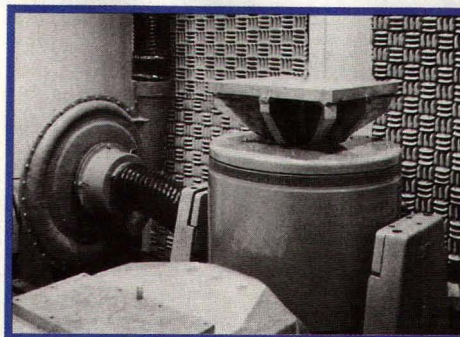
Amplifiers
Switches
Power Dividers
Hybrid Couplers
Directional Couplers



**MID-ATLANTIC
RF SYSTEMS, INC.**

PO Box 745,
Forest Hill, MD 21050
Tel.: 410/893-2430
Fax: 410/638-5193
email: info@midatlanticrf.com
www.midatlanticrf.com

looking back



ALMOST 21 YEARS AGO, a report on the small-but-innovative firm RHG Electronics (Deer Park, NY) highlighted the company's in-house capabilities in vibration testing according to MIL-STD-810 and STD-202 guidelines.

next month

Microwaves & RF April Editorial Preview Issue Theme: Wireless Technology

News

Attendance at the recent Wireless Systems Design Conference & Expo (San Jose, CA) was strong and visitors were enthusiastic about upcoming wireless business prospects for the remainder of 2003. Some of the key market opportunities, including in Bluetooth and WLANs, were not surprises. But a number of companies revealed designs targeting embedded GPS applications and large potential markets in automotive telematics applications. Don't miss this exclusive wrap-up of key products and technologies from the February 2003 wireless show.

Design Features

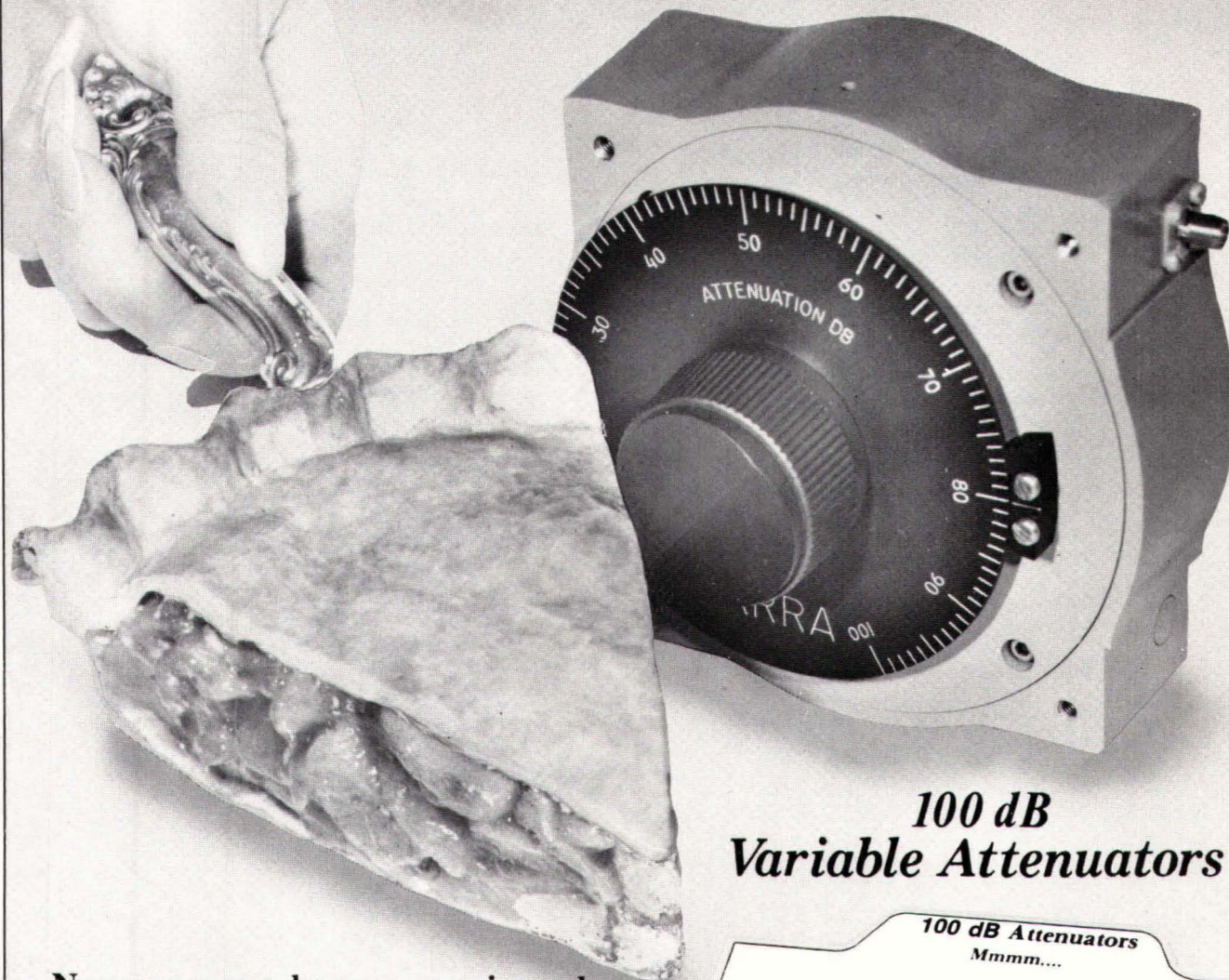
Design Features in April cover various aspects of wireless design and simulation. An author from Motorola, for example, explores ways for integrating EDA tools with load-pull measurements, while an author from Agilent Technologies will compare measurement methods for evaluating the equivalent-series resistance (ESR) of capacitors and inductors. Additional technical articles in April will reveal techniques for constructing gain-slope

equalizers for millimeter-wave amplifiers, highlight measurement methods for checking the performance of high-power amplifiers with the burst waveforms commonly found in many modern communications systems, and detail the design of a packet-division-multiple-access (PDMA) receiver for wireless Internet applications.

Product Technology

In April, the Product Technology section will road test a new line of wafer probes designed for testing high-frequency silicon-based IC technologies, such as SiGe. The probes achieve low contact resistance by means of lithographically defined thin-film contacts on a multilayer polyimide membrane. Also in April, a well-known supplier of trimmer capacitors unveils a new line of VCXOs, while additional stories describe an innovative blind-mate connector, a novel analog circuit that improves the distortion (dynamic-range) characteristics of power amplifiers, and a unique millimeter-wave Grid amplifier technology capable of achieving tube-like power from semiconductor amplifiers.

Get a piece of the ARRA pie...



100 dB Variable Attenuators

Now, you can have your pie and eat it too! Only from ARRA! Four models that cover the 500 to 8000 MHz frequency range! Available in lower attenuation ranges. *Customerized to your requirements with little or no additional charge.* Top performance. Super dial accuracy.

- Direct reading dial
- Extremely high reliability
- Non-contacting movable parts (our special recipe)
- High power version available (up to 200 W)
- Usage will not change calibration
- Attenuation will not vary with temperature
- Excellent phase characteristics
- Type N standard SMA connectors available

Applications include:
• TACAN • DME/IFF • Lab standards • Altimeter
Or any other requirements needing high attenuation and accurate dial reading.

Visit our website at www.arra.com
E-Mail: sales@arra.com

100 dB Attenuators Mmmm....		
Freq Range	Atten vs Freq - dB	Model #
500 - 1000 MHz	1.5	2952 - 100
900 - 1300 MHz	0.75	2-3952 - 100
1000 - 2000 MHz	1.5	3952 - 100X
2000 - 4000 MHz	1.5	4952 - 100 X
4000 - 8000 MHz	1.5	5952 - 100X
Insertion loss - 6 dB		
VSWR - 1.5		
Power - 15 cw		
Temperature -30 to +120 C		

Some of the best attenuator recipes you can find are cooking at ARRA right now! Send for your copy today and get a piece of the ARRA pie.

... the last word in variable attenuators

ARRA INC.

15 Harold Court • Bay Shore NY 11706-2296

Tel 631-231-8400

Fax 631-434-1116

Let our brainstorm add strength to yours...

NEW!



Let the industry's lowest-cost, highest-performing transformers transform your cell phone, wireless-LAN chipset, or Bluetooth™ design.

Anaren innovation strikes again — with our new family of Femto-sized Xinger®-brand transformers! Perfect for next-gen 802.11 wireless chipsets, handhelds, and Bluetooth™ platforms — Anaren FBs replace ceramic and Lumped Element printed circuit-board baluns for monster performance and price gains.

- As small as 0.120 x 0.120 x 0.035" (3.05mm x 3.05mm x 0.89mm)
- Low 0.5dB insertion loss and market-leading phase & amplitude balance vastly improve power consumption, noise figures, dynamic range
- Class-leading return loss makes FBs mis-match tolerant
- Available in tape/reel
- Available in 50-50Ω (100Ω Balanced)
- Choose from 2.4-2.5 GHz and 5.15-5.35 GHz

To learn more, call for a quick-quote — or email pbfb@anaren.com



Designing a small PA? Have we got an itsy, bitsy 10 or 20 dB directional for you!

With our new Xinger®-brand directional couplers in your design arsenal, you can think as small as you like — and design in killer performance at a cost comparable to ceramics!

- Choose from 1.7-2.0, 2.0-2.3, and 2.3-2.7 GHz
- Measures a mere 0.20 x 0.25 x 0.065" (5.1 x 6.4 x 1.7 mm)
- Power handling up to 20 Watts
- Tightly controlled coupling: +/- 0.75 dB
- Low insertion loss of 0.20 dB/typ
- Low return loss of 23 dB/typ
- Superior directivity, at 24 dB/typ
- Extremely temperature stable vs. ceramic, plus compatible with no-lead solder

Call for a quick-quote — or e-mail picodirect@anaren.com.

NEW!



"B-style" couplers from RF Power: The lowest-loss parts in their class. Period.

Working on a high-power amp? Balanced amplifier? Signal distribution platform? Have we got a high-power, very low-loss coupler for you!

- True SM, on tape and reel — measures 1.0 x 0.5" (25.4 x 12.7 mm)
- Insertion loss as low as 0.10 dB!
- Power handling up to 400 Watts
- Frequency ranges from 400 to 2300 MHz
- Supports: UHF, AMPS, GSM, DCS, PCS, and 3G
- Arrives 100% tested, for guaranteed, reliable performance

Call for a quick-quote — or e-mail rfpcoupler@anaren.com



Termination, attenuator, and resistive options galore!

These days, you need more solid-performing, cost-competitive resistive product options than ever before — and our vast RF Power-brand product line delivers!

- Choice of frequencies: Excellent VSWR performance from DC to 6 GHz
- Materials options: Choose from Aluminum Nitride (AlN), Beryllium Oxide (BeO), or Alumina (Al2O3)
- Wide power range: From 4 to 1600 Watts — and everything in between!
- Package styles: Surface mount, chip, flangeless, flanged, and cable loads — and all SMs come on tape and reel, at no additional cost!
- Rugged and reliable, guaranteed: Thanks to state-of-the-art, thick-film construction techniques and equipment. And each part is 100% tested, guaranteeing solid, repeatable performance.

Call for a quick-quote — or email rpfamily@anaren.com

Anaren®
What'll we think of next?™

800-411-6596 > www.anaren.com
In Europe, call 44-2392-232392 > ISO 9001 certified
Visa/MasterCard accepted (except in Europe)